RADIO and ELECTRONICS

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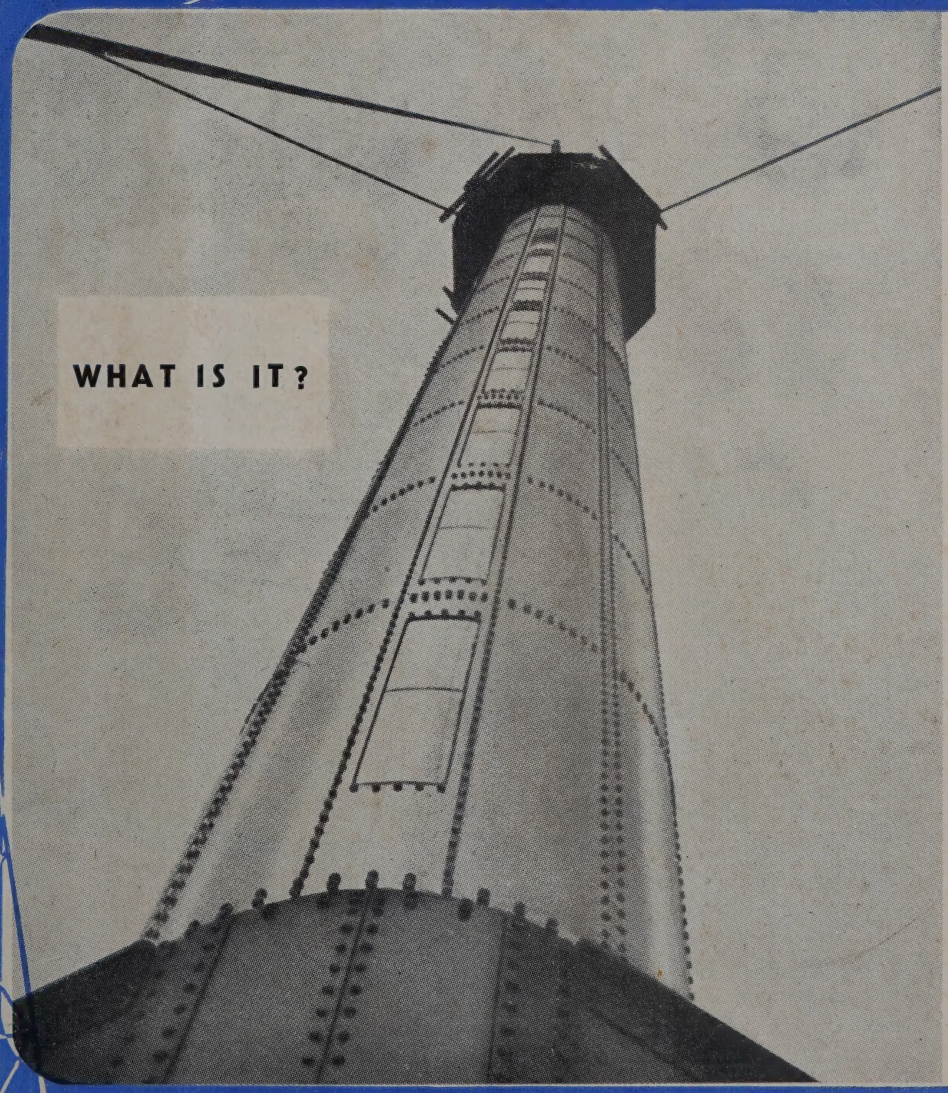

WHAT IS IT?

In this Issue

A Flexible
Test
Instrument

A 2-Metre
Converter

Data on the
834

S.S.S.C.

NOVEMBER, 1st, 1951 VOL. 9, NO. 8 1/10

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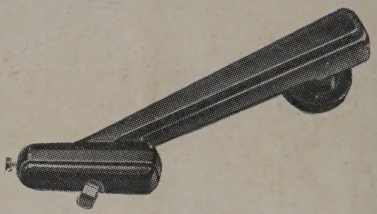

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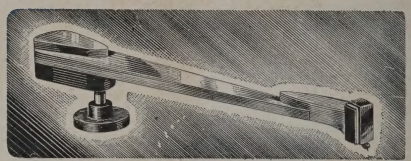

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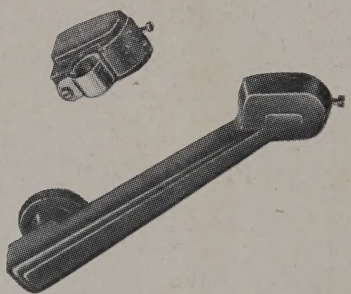

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RADIO AND ELECTRONICS

Vol. 6, No. 9 1st November, 1951

	Page
Editorial	2
A Converter for the Two-Metre Band	4
A Flexible Test Instrument, by C. D. Cook	8
Radio Roundabout:	
Review of the London Radio Show, 1951	13
Meteor Research	13
Radio (1936) Ltd. Honours Service of its Staff	13
Shoes and Ships: The Virtues and Uses of Negative Feedback	17
Tube Data: The 834 V.H.F. Transmitting Triode	21
The Philips Experimenter: No. 49: How S.S.S.C. is Produced	24
The Annual Conference of the N.Z. Radio and Television Manufacturers' Federation	27
The "Radio and Electronics" Abstract Service	30
For the Serviceman: The Philips Model 595	31
New Products: Latest Releases in Electrical and Electronic Equipment	37
Proceedings of the New Zealand Electronics Institute (Inc.)	39
The "Radel" 6-Metre Amateur Receiver: Part III (Conclusion)	46
Trade Winds	41
The "R. and E." Amateur Television Project: Part VII	43
Classified Advertisements	42

OUR COVER

The cover photograph this month is not a chimney, but an aerial array, of the new "slot" type. It consists of four vertical stacks of slots spaced round a metal cylinder and produces a horizontally polarized wave. The one shown constitutes the top section of the 750-foot mast erected at Holme Moss for the B.B.C.'s latest high-powered television transmitter, and is to be used at a later date for V.H.F. sound broadcasting. The TV aerial is on top of the "chimney."

●

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A NEW BROADCASTING SYSTEM?

In our August editorial, we mentioned a press report concerning an allegedly new system of broadcasting which, according to the report, was to resolve, once and for all, the seemingly endless controversy between the A.M. and F.M. exponents, by the simple expedient of outmoding both of them at one blow, like the tailor in the fairy story. Indeed, we did more than mention the report, since we went so far as to point a moral, and to criticize the publication by the Press of statements which have not been examined for accuracy and, indeed, for technical veracity.

It appears that our strictures were ill-founded, and that an apology is due to the person or persons unknown at whom the criticism was directed, for the arrival of recent issues of British technical periodicals has made it clear that the responsible party was no less a person than the British Postmaster-General! The phrase "officialdom run riot" may have reached the status of a cliche, but it seems to be justified here, if ever it was.

It should be realized that in the United Kingdom, the A.M./F.M. controversy is a live one, in that responsible quarters have already decided that some form of V.H.F. broadcasting is desirable there in order to supplement the existing "broadcast band" transmissions without consuming more ether space in a part of the spectrum where space is virtually non-existent. In view of this, any pronouncement by an allegedly responsible authority is of inestimably greater importance than a mere press report, not only to the great British radio industry, but to the public as well. The P.M.G.'s statement, issued during a debate in the House of Commons on the White Paper on the Beveridge Report on Broadcasting, was to the effect that "Research has discovered an entirely new consequence which entirely sets aside all the reasons for giving favour to one or the other" (A.M. or F.M.). Technical authorities are frankly sceptical that this is even possible, unless the term "entirely new" must be taken not in a technical sense, but in a political one. In the latter event, it seems likely that the "new" system is pulse modulation, which would certainly appear to have advantages over both A.M. and F.M. for V.H.F. broadcasting. The reason given for not divulging the nature of the startling new system was that it had not been tested and proved.

This is a most extraordinary state of affairs. It is difficult, if not impossible, for such a thing as a really new principle in radio transmission to be developed in such secrecy that even the best-informed technical brains cannot imagine what it should be. Even if a radically new system has been invented, it can hardly be tested in secret! Indeed, as one writer has suggested, the idea of secrecy applied to broadcasting, which is possibly the most public of all public utilities, savours rather of Lewis Carroll in his lighter moments—certainly not of Dodgson the mathematician! And supposing again that this new scheme exists, what possible reason can there be for secrecy regarding it? If there is a case for secrecy on security grounds, then the P.M.G. must have been guilty at the very least of an offence against the Official Secrets Act in suggesting publicly that it be used for broadcasting. The whole business fails to make sense, not in one direction only, but in any way at all, and yet it emanates from a Minister of the Crown. Need more be said? At least, we can now say that it emanated from a former Minister of the Crown. Perhaps his successor will clear the matter up.

A NEW RADIO PUBLICATION

We would like to draw the attention of readers to a short announcement elsewhere in this issue concerning a new magazine, to be entitled *Radio-Gen*, and sub-titled "For the Audio and Radio Hobbyist." It is hoped that this new magazine, which is to be published monthly, will fill a need which it is considered exists for a small inexpensive paper devoted solely to the requirements of those who pursue radio as a hobby. It is recognized that many readers of *Radio and Electronics* do just that, but in the natural course of events, a paper which addresses itself to the more advanced devotees, whether amateur or professional, does not appeal to a great many possible readers whose tastes are purely those of a hobbyist.

In short, a good many people in this country who are interested in audio and radio are not being catered for at present, and it is to those who feel that this is so, that *Radio-Gen* is being addressed. No change is envisaged in the policy of *Radio and Electronics* as a result, and it is hoped that a good many of our present readers will find material in the new paper which will interest them.

As we said in a recent editorial, the more people, of all ages and tastes who can take an interest in things electronic, the better, and we feel that in trying to fill a gap in New Zealand's radio literature something worth-while is being attempted. We cordially invite inquiries from all who may be interested in the new publication and these should be addressed to "The Managing Editor, *Radio-Gen*, P.O. Box 8022, Wellington."

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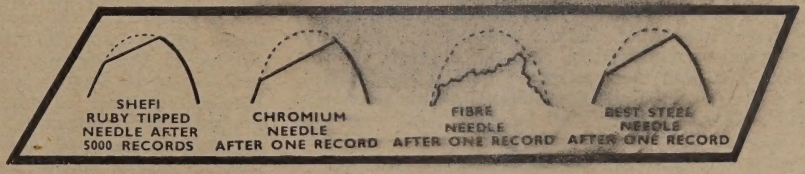

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The R. and E. V.H.F. Programme

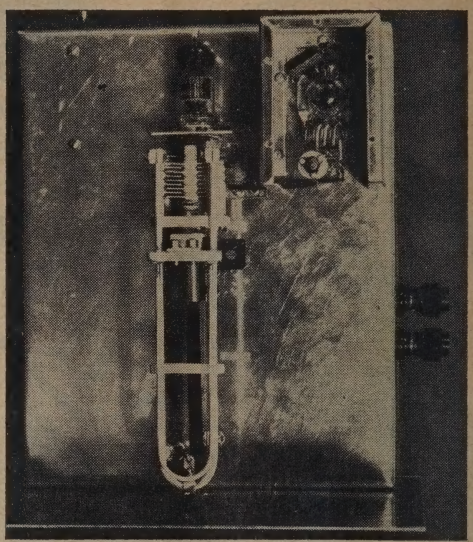
A Converter For The Two-Metre Band

The original explanatory article on the "R. and E." V.H.F. Programme announced that following the description of a special 6-metre receiver, we would describe converters, which could be used with this receiver to extend its usefulness to cover both the 144 to 148 and the 420–260 mc/sec. amateur bands. The first of these converters is the subject of this month's article in the series. In addition, readers who have been following the series describing the 6-metre receiver will find the completion of the article elsewhere in this issue.

SCHEME OF THE CONVERTER

Since the 2-metre band is only a narrow one, covering no more than two megacycles on either side of a centre-frequency of 146 mc/sec., it is entirely practical to employ the broad-band technique. That is to say, the oscillator of the converter is fixed in frequency, and the input and output circuits are broadly tuned in order that the whole of the 2-metre band is accepted, and converted to the lower frequency range of 50 to 54 mc/sec. Then, in order to obtain continuous tuning, the 6-metre receiver is tuned through its band, and so picks out all signals that may be present in the original frequency range. The whole arrangement amounts to a double-conversion superheterodyne, in which the first I.F. is made tunable.

In order for such a scheme to work, both the output circuit of the converter, and its input circuit, too, must have a broad enough response to accept all the signals in the desired band without attenuating any of them too much, and this broad response is obtained by "broad-banding" these two circuits. The simplicity of the circuits is such, however, that the required broadness of response is easily accomplished. It would be possible, though, to make the input and output circuits of the converter tunable, with controls brought out to the front panel, but this would give two extra controls to be adjusted each time a signal was tuned in, and would make the business of searching the band very tiresome, and, indeed, difficult, if one were to be sure of not missing any signals. If a piece of equipment is to be made to have a broad response, then this cannot be done for nothing. As everyone knows, the tuned circuits in receivers have two quite distinct purposes. One is to provide voltage amplification, and the other is to give selectivity. For both these purposes, a high Q is needed, so that if the Q of the circuits is low, both the selectivity and gain of the receiver will be less. And since the easiest way of obtaining a wide pass band is to lower the Q of any tuned circuits that may be present, such a process will also lower the amplification obtained. This is exactly what is done in a converter of the so-called broad band variety. If, for example, we place a circuit in the output of the mixer valve, and tune it to 52 mc/sec., then the chances are that the selectivity will be so high that the amplification at 50 and 54 mc/sec., the edges of the band, will be several db. less than at the centre. This is not usually a desirable state of affairs, and is one that is usually avoided by ganging, but it is hardly possible to gang a dial on the converter with the main dial of the receiver, so that the only alternative is to reduce the selectivity of the converter's output circuit. This can be done by the simple expedient of shunting the tuned circuit with a resistor. If after this has been done, the overall gain of the converter and receiver is not more than 2 db. lower at the edges of the band than at the centre, where the converter is still tuned "on the nose," the difference will be quite unnoticeable, and the performance will be satisfactory.



Above-chassis view of the converter showing the input tuned line, and the oscillator in its shield box.

The same considerations exactly, refer to any tuned circuits within the converter, for all must pass the whole of the signal band without attenuation, or, if they do not, they must be tunable. In the case of the only other tuned circuit in the present job, the latter course has been decided upon, for the following reasons:

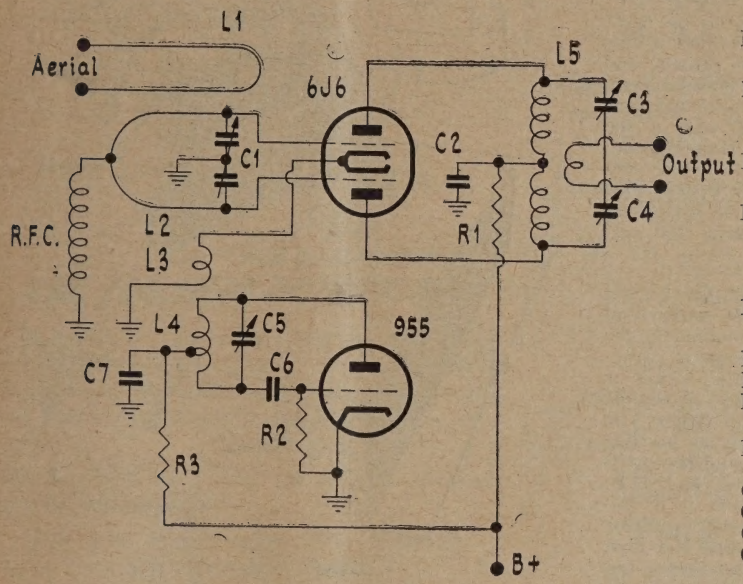
It should be obvious enough that the performance of any device which has been broad-banded will not be as good as if all circuits could be individually adjusted to suit the signal of the moment. In particular, signal-to-noise ration,, and therefore, weak-signal performance suffers if the circuits tuned at signal frequency are not able to be peaked on the actual signal that is being received. In spite of this, when modern high-Gm tubes are used, performance is very good indeed, and the convenience of the fixed-tuned, broad-band converter is such that it always merits serious consideration. From the constructor's point of view, the scheme's greatest advantage is that no difficult ganging or tracking problems are encountered, and where compactness is particularly desirable, as in mobile equipment, it is very readily obtained.

CIRCUIT OF THE CONVERTER

The circuit is a particularly simple one, as a glance at the diagram will show. A 6J6 (or ECC91) is used as the mixer, and a 955 is the oscillator. In order to use the 6J6 to best advantage, the mixer circuit is push-pull. This presents no difficulty, especially when it is intended to use an open-wire line as the input tuning circuit, since the line is balanced, and works most easily into a balanced tube circuit. Now in arranging a push-pull mixer, there are a number of ways in which the tuned circuits and the injection voltages can take place. If both the

signal and the oscillator voltages are injected in push-pull, then the output (I.F.) circuit must be in parallel. Alternatively, as here, the signal and output circuits can be in push-pull, with a single-ended application of the oscillator voltage. The remaining possibility (seldom seen because it is not as convenient as either of the other arrangements) is to have push-pull injection of oscillator voltage, push-pull output, and single-ended signal input circuits. Readers might well ask why one of these three configurations must be used. The answer is very simple, namely that these are the only three arrangements that will give the required sum or difference frequencies in the output. For instance, if in the present case, we connected the mixer plates in parallel, with a tuned circuit in series in the usual way, the I.F. outputs from the two halves of the circuit would cancel each other out, and the result would be zero output at the desired I.F. The same thing goes for any of the other possibilities involving a push-pull mixer. What it boils down to is this, that in a push-pull mixer circuit, two of the three voltages must be connected in push-pull. Thus, if the signal input circuit is balanced, as here, either the output must be taken in push-pull, with the oscillator supplied in a parallel manner to the two halves of the mixer, or else the oscillator must be applied in push-pull, and the output taken in parallel. It will be remembered that in the 6-metre receiver, where we also used a push-pull mixer, both signal and oscillator were applied in push-pull to the mixer grids, while the plates are paralleled and connected to the single-ended I.F. transformer primary. In that case, we had no alternative, if standard commercial I.F. transformers were to be used. Here, we can easily make our own tuned circuit for the output of the mixer, and couple it to the receiver through a small link, and there is no disadvantage in making the output circuit a balanced one. It is then easiest to inject the oscillator to the common cathode of the mixer, thus satisfying the necessary conditions.

With the above considerations explained, there is not very much that need be said about the circuit. The oscillator works on its fixed frequency of 94 mc/sec. Thus, a signal frequency of 144 mc/sec. beats with it to produce an I.F. of 50 mc/sec., and a signal of 148 mc/sec. gives output from the mixer on 54 mc/sec. Thus it can be seen that any signal in the 2-metre band beats with the fixed oscillator to produce a new signal somewhere inside the 6-metre band, and therefore tunable on the main receiver. The output circuit is tuned to 52 mc/sec., while the signal circuit, consisting of the tuned line has its tuning condenser brought out to the front panel so that it can be peaked for any particular signal. It might be thought, after our previous dissertation on the necessity for broad-banding the fixed-tuned circuits, that this extra control might prove a nuisance in actual use. In practice this is not so, and the reason is to be found in the fact that the higher we go in frequency, the more difficult it is to obtain selectivity. As a result, although we do not load the input circuit with resistance, its selectivity is not so great as to cause difficulty in tuning. The circuit is not so broad that no re-tuning is needed over the band, but on the other hand it is not so narrow that it cannot be left set while a considerable portion of the band is explored with the tuning knob of the main receiver. All the input circuit needs in practice is a slight re-adjustment every now and again, while searching, and then a peaking adjustment, for best results, once a station has been received. In this way, the full selectivity and gain of which the input circuit is capable is made use of.



L_1, L_2, C_1, commercial tuning line with built-in butterfly tuning condenser.

R.F.C. choke made by winding one layer of 3-gauge wire on a 10k. carbon resistor, 1 watt size.

L_4, oscillator coil, 6 turns, 20-gauge wire, $\frac{3}{8}$ in. diameter, spaced to occupy $\frac{3}{4}$ in.

L_5, output coil, 8 turns, 20-gauge, $\frac{5}{8}$ in. diameter, in two halves of four turns each, spaced $\frac{3}{8}$ in. apart, leaving room for a three-turn coupling link.

L_3, 1 turn oscillator coupling loop, close to oscillator coil.

R_1, 2k. watt.
R_2, 100k, $\frac{1}{2}$-watt.
R_3, not shown, 2500 ohms, shunted across L_5.
R_4, R_5, not shown, 27 ohms, grid-stoppers for 6J6, mounted right at grid pins.
C_2, C_7, 0.001 mica.
C_3, C_4, Philips trimmers, 3–30 $\mu\mu$f.
C_5, Philips trimmer, 3–30 $\mu\mu$f.
C_6, 15 $\mu\mu$f. silvered ceramic.

Oscillator coupling to the mixer is via a short link, connected directly in the cathode lead, at one end, and terminating in a one-turn coupling coil at the other. The coupling of this small coil to the oscillator tank circuit can be varied as a means of altering the amount of oscillator voltage injected into the mixer.

As the smallest and most economical method of obtaining balanced tuning for the I.F. output coil, two Philips trimmers in series are placed across the coil and used as a split-stator condenser. Since these have to be adjusted only once, the fact that there are two separate condensers is not a disadvantage.

Aerial coupling is by means of a hairpin loop, whose coupling to the input circuit can be simply varied by bending. The open ends of the loop are taken to the twin aerial terminals, so that the input circuit as a whole is

suitable for connection to an open-wire line from the aerial.

No built-in power supply is provided, because the H.T. requirements are very light, and can easily be "filched" from the power supply of the main receiver.

A MISTAKE IN THE CIRCUIT DIAGRAM

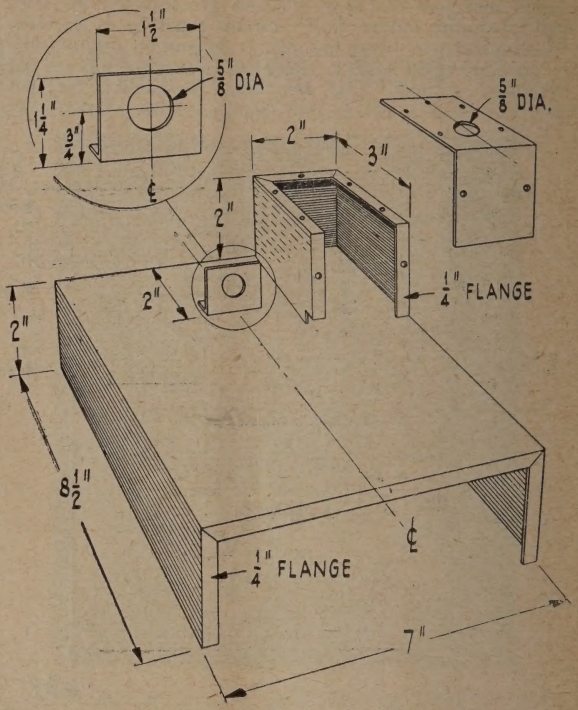
We must draw the attention of readers to an error in the circuit diagram which could not be rectified in time for publication of this issue. The cathode resistor and bypass condenser for the mixer have been omitted from the diagram. These parts are wired in parallel and connected in the cathode lead at the earthed end of the oscillator coupling coil. That is to say, the coupling coil, instead of going directly to earth, goes to the upper end of the cathode resistor in parallel with its bypass condenser, while the other end of this combination is earthed. The resistor is 3000 ohms, and the condenser 100 $\mu\mu$f.

CONSTRUCTION

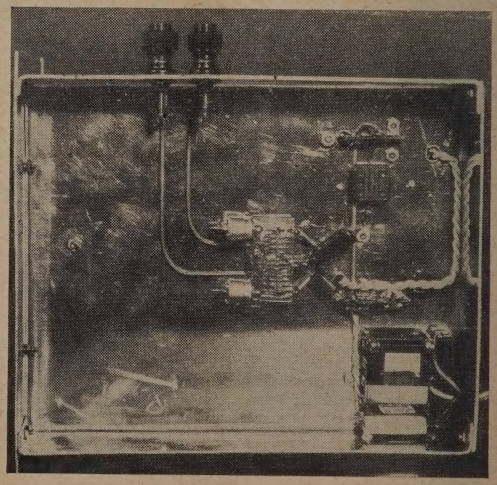
The photographs and the chassis diagram give a good idea of the method of the construction. A commercial tuning unit is used at the input, and is mounted in the centre of the chassis, in front of a small bracket carrying the mixer valve socket. The oscillator socket is mounted near the back right-hand corner, on top of the chassis, and is surrounded by a built-up shield. The purpose of this shield is to eliminate as far as possible any accidental coupling between the mixer and the oscillator. This point is not always taken care of in V.H.F. converter arrangements, with the result that it is impossible to tell just how much the intentional oscillator coupling is contributing to the overall result. Not that this matters very much as long as the thing works, but where stray coupling is the main method. such apparently minor changes as reversing the direction of winding of the oscillator coil may make a large, and unaccountable, difference to the performance of two otherwise identical equipments. A hole in the top of the shield box allows the Philips trimmer of the oscillator to be adjusted without removal of the cover. The small piece removed from the front corner of the oscillator shield allows the two wires from the coupling coil L_3 to come out of the oscillator compartment, and they can be seen in the top-chassis photograph. The cathode resistor and condenser of the mixer can be seen mounted close to the oscillator box, with one of the wires from inside it going to their junction.

The oscillator coil is self-supporting, mounted on a small piece of perspex, in the following way. Where the ends of the coil are to be fixed, small holes are drilled in the perspex, just large enough to accommodate the rivet end of a rivet-end solder lug. On the other side of the perspex, the hole is countersunk, so that on insertion of the rivet, it can be spread, and will hold, even though it is not long enough to come right through the perspex sheet. The same sort of mounting is used for the output circuit, which can be seen under the chassis. Here, the coil is in two halves, to allow the coupling turns to be placed between them, at the centre of the coil. The perspex strips which support the oscillator and output coils are held to and spaced from the chassis by two screws, with distance-pieces about half an inch long. The input circuit contains its own built-in butterfly condenser, which is brought to the front as the tuning control, while bandsetting is carried out by adjusting the length of the line, which can be slid through the two mounting bushes, and any excess trimmed off.

The second and final instalment of this article will describe the procedure to be adopted in adjusting the converter for use.



Perspective view of chasis, oscillator box and mixer mounting bracket, showing necessary dimensions.



Under-chassis view of converter.

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A Flexible Test Instrument

By C. D. COOK

This simple, but constantly useful adjunct to any workshop where electronic equipment is used or repaired, had its birth when the Hamilton Public Hospital radio installation required its annual overhaul. The installation consists of a rack-and-panel edifice standing eight feet high, containing 28 valves spread through two 6-valve tuners, two push-pull 6L6 amplifiers, and their drivers, one microphone pre-amplifier, and two complete power supplies. In addition, a record-changer, a 10-inch monitor speaker, switching gear for inter-change of programmes, switches for 12 wards and 300 bedside double outlets; an angle-iron frame and sheet steel plates, all add up to a weight which brings grunts from four strong men. Its crowning glory from the serviceman's point of view, lies in the fact that no panel is detachable from the others, since all connections are made via loomed multiwire cables with no provision for disconnecting.

The serviceman's eagerness is still further subdued when he finds that the radio-room is now used as a store-room, with the result that before he can get on with the job he has to man-handle a few dozen iron liquid gas bottles and some shoulder-high stacks of durocaine cartons in order to reach the side walls and the only power point in the room. By the time he has plugged into this power-point a bunch of tapon plugs and his soldering iron, his signal generator, his signal chaser, and an inspection lamp, not to mention any other aids he may have brought with him, he is about ready to crawl out from the maze of flex, leave his tools and spare parts and spare valves in the debris and retire to a nice peaceful mental home!

Obviously, something had to be done; so it was decided to bring together in one easily portable case (1) a multitester, (2) a signal chaser, (3) a noise localizer, and (4) a leakage indicator which, for want of a better name, we will call a simple megger.

The signal chaser is a simple three stage amplifier comprising two halves of a 6SN7 valve cascaded, feeding a single 6V6GT valve, the whole being preceded by a shielded probe containing a 1N34 as de-modulator. The reproducer is a Rola 8M permanent magnet speaker.

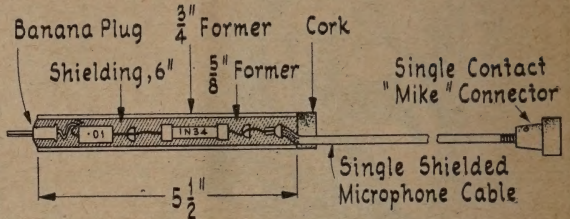
The noise localizer is merely the same amplifier, capacity-coupled to a "straight" needle-tipped probe connected to a 200-volt source through a resistance line which limits the current to 1 milliampere.

The low-range megger is achieved by switching the 1 mA movement of the multitester into the 200v. 1 ma. resistance line. This permits actual readings up to 10 megohms, and indications up to 30 megohms.

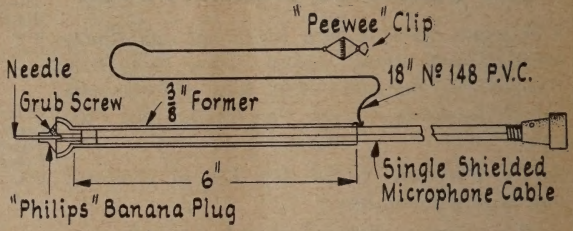
The multitester gives twelve ranges of voltage, current, and resistance on direct current; and five voltage ranges on alternating current. Thus, five ranges of audio output voltage are automatically provided.

Except for the multitester prods, the chaser probe, the noise and meggar probe, and the power flex, the instrument is contained in a tinned-steel "box" with an aluminium panel, the whole standing on four rubber feet to "hold" the bench and to minimize microphonics.

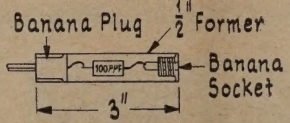
Several servicemen have disapproved of the size of the cabinet on the score of decreased portability. But it should be understood that though this instrument was built to facilitate the handling of one regularly recurring outside job, it has proved its worth also as a permanent aid in the workshop where its uses are legion. Consequently, with this end in view, it was decided to depart from the established practice of utilizing about a four-inch speaker in a chaser, and to use an eight-inch speaker in a combination instrument. Obviously, in trying to find the seat of the trouble in a quality receiver which is not giving audio output of the reasonably expected standard, it is absurd to use a chaser which incorporates a speaker incapable of giving at least a comparable standard of output. Since the great run of decent receivers used not less than an eight-inch speaker, it was decided that this chaser should use an eight-inch one also, and the cabinet was planned accordingly.



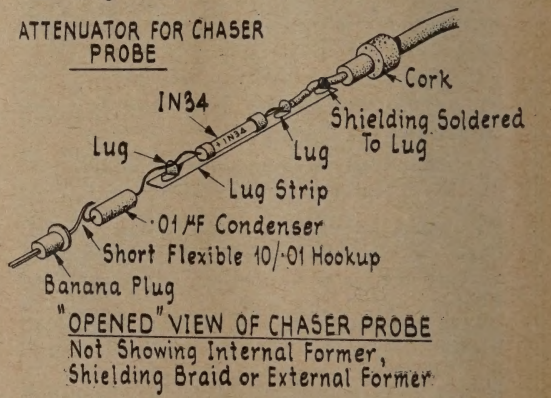
CHASER PROBE



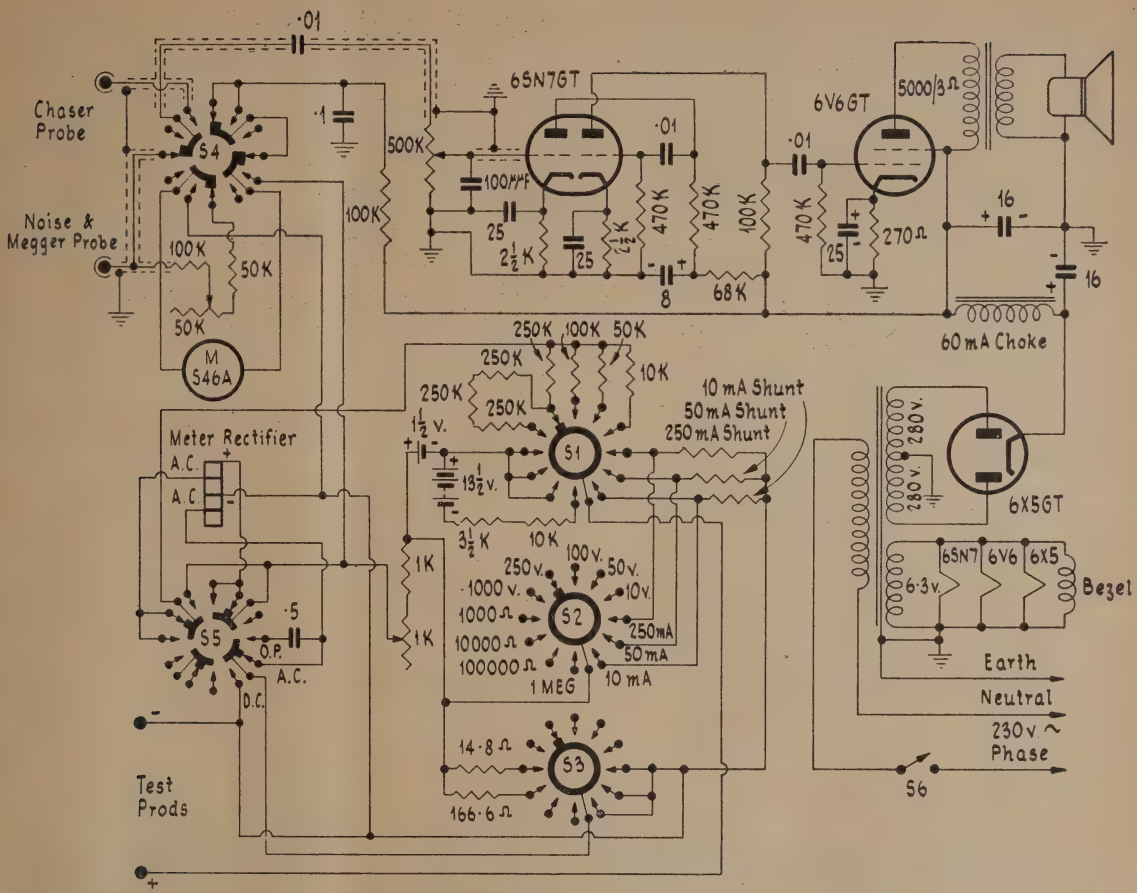
NOISE | MEGGER PROBE



ATTENUATOR FOR CHASER PROBE



"OPENED" VIEW OF CHASER PROBE
Not Showing Internal Former, Shielding Braid or External Former



It may seem peculiar that the chaser probe and the noise/megger probe use the same type of connecter (*i.e.*, single-contact microphone connecter), but the reason is that by connecting the "straight through" probe in place of the chaser probe we are presented with an ideal method of checking record players and other devices which normally precede an amplifier. With the probes connected back in their places, the triple main functions of the instrument are selected in a fool-proof manner by the four-pole three-position switch to the left of the range selector. Incidentally, the four pole successfully prevents possible costly damage to the meter while switching it from the tester circuit into the 200-volt line from the power supply.

The multitester is the well-known University circuit, and was chosen for its simplicity, its reliability, and the full availability in New Zealand of all the necessary University components. The only modifications we have made are the exclusion of the 1 ma. range ,the inclusion of the multiplier for the 100volt range, and provision for completely switching the meter out into the megger. Consequently, it now provides the following ranges:

0-10 ma., 0.50 ma., 0-250 ma.; 0-10v., 0.50v., 0-100 v., 0-250v., 0-1,000v. A.C. and D.C.; 0-1000 ohms, 0-10,000 ohms, 0-100,000 ohms, 0-1 megohm.

The power supply deserves no special mention beyond the use of the indirectly heated 6X5 rectifier which ensures that the filter condensers and the megger will never be subjected to initial surge voltage.

To many, the purpose of the noise localizer may be shrouded in mystery, so a word of explanation is necessary. In days gone by a doubtful coil or transformer winding was often tested for corrosion (greenspot) and continuity, by connecting it in series with a battery and a pair of headphones. However, by using the noise probe, the current from the 200-volt power supply flowing through a defective coil will cause loud crackles, bangs, or frying noises to emanate from the speaker, to the accompaniment of fluctuating readings on the meter. If the coil is in good order the speaker will make no erratic sounds and the meter will show constant deflection in keeping with the D.C. resistance of the coil under test. If the coil has an open circuit and the speaker gives no sound, the meter will show infinite resistance, *i.e.*, no deflection. It should be mentioned that if this instrument is used near a fluorescent light, even an open (no continuity) coil will work as a pick-up device, and the 50-cycle mains alternations will be heard but as this is a characteristic sound it can be disregarded.

This is by no means the only use to which the localizer can be put, for it can show up noisy valves, shorting or dirty variable condensers, noisy resistors, noisy fixed condensers, poor quality (leaky) insulations in lug-strips, terminal boards, valve sockets, transformers, and coils,

etc. Another instance of the way work can be speeded up is the case of speaker voice coil circuits which are suspected of having no continuity. If the localizer probe be connected across the output transformer primary terminals and the gain control turned fully on, loudly unmistakable feedback will be heard if the speaker circuit is in order; and at the same time the primary will indicate its faultiness or otherwise—and all this without having to unsolder the closed voice coil circuit.

Any noise caused by faulty welding, etc., in a valve will show up if the valve is tapped lightly with a pencil while the probe-clip is connected to one pin of the valve and the probe tip is held on to another pin or the grid cap of the same valve.

The only precautionary measure in using the localizer, lies in *ensuring that the only voltage applied to the component under test must come via the probe.* In other words, if it is desired to test some part of a radio receiver, first remove the receiver power plug from the main supply, or, in the case of a battery receiver, completely disconnect the batteries.

The signal chaser tip can be touched directly on to any part of a receiver or amplifier whether any D.C. potential is present or not. If the receiver is not earthed through the power flex, the earthing clip of the noise probe should be firmly attached to H.T. negative (usually chassis) of the receiver so that the return circuit to the chaser will be completed. If any signal is apparent at a by-passed cathode or screen, the by-pass should be replaced. Also, if reproduction through the chaser is better than that of the job under test, then obviously the job needs some attention. It goes without saying that using the chaser is the simplest means of ascertaining how far the incoming signal can progress through a seemingly dead receiver or amplifier.

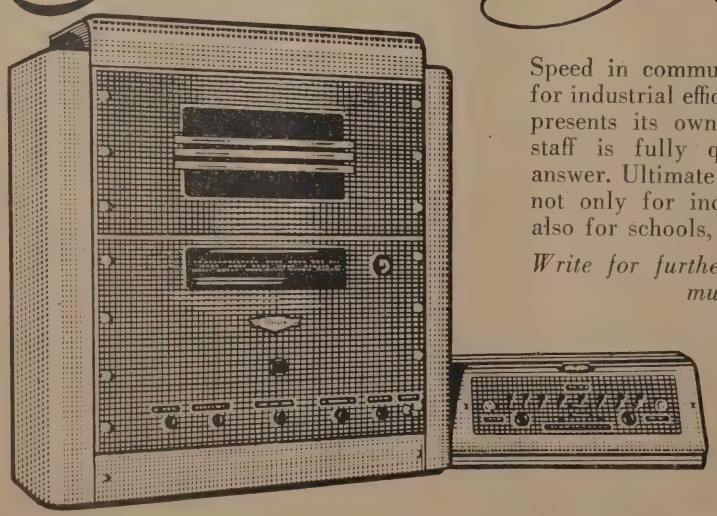
The attenuator adapter contains a small mica condenser which will pass much less signal than does the condenser in the chaser probe, so that when the adaptor is plugged on to the probe the signal reaching the 1N34 is more manageable, and the demodulated signal reaching the chaser amplifier is free from "burble" and is easily controllable.

Provided the circuit is closely followed, and the layout is roughly followed, there is no difficulty for the constructor as long as he observes normally careful wiring procedure.

MISCELLANEOUS NOTES

S_1, S_2, S_3 are the three wafers of the three-bank single circuit 12-position continuous rotation multitester selector switch. In wiring, it is simplest to make S_3 the wafer nearest to the panel, and S_1 the wafer remote from the panel. S_4 is the function selector switch, single-bank four-circuit three-position. Though it might appear that a three-circuit switch could be used here, it is important to use a four-circuit as shown in order to ensure a break-before-make action, thus preventing costly accidents when switching to or from the megger function which puts H.T. voltage on the meter. S_5 is the A.C./D.C./output change-over switch. For simplicity in ordering, this is the same as S_4, though a single-bank, three-circuit, three-position switch is all that is actually required. S_6 is the mains on/off switch which is part of the 500k. gain control.

The metal case of the gain control is automatically earthed to the panel when the control is mounted; but



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it is of some importance that the earthy end of the gain control element be earthed via an insulated lead to the same point as the 6SN7GT input cathode is earthed. This avoids hum pick-up caused by eddy currents in the panel and in the chassis.

The chassis is bent from one piece of 20-gauge tinned steel, with a ⅜ in. flange bent under all round for both mounting and strengthening.

The panel is 16-gauge aluminium, though dural would be as suitable. The University meter is calibrated for use on a non-ferrous panel.

Editor's Note.—Space has prevented our printing in this issue the chassis diagrams and photographs of Mr. Cook's instrument, but these will appear in the December issue, together with the remainder of Mr. Cook's notes on the instrument.

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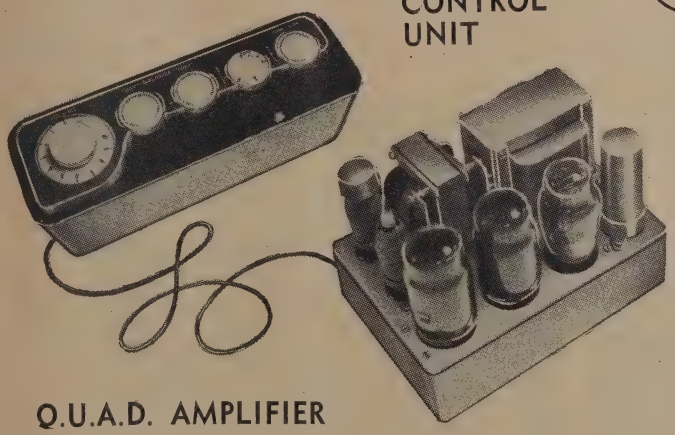

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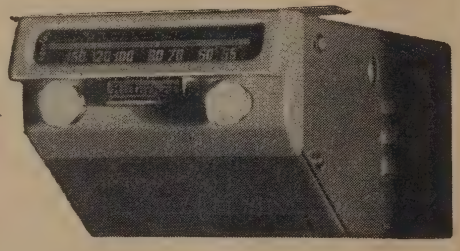

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Radio Roundabout

Review of the London Radio Show, 1951

A great emphasis at the 18th National Radio Show, held at Earls Court, London, from 28th August to 8th September, was laid on export models of radio receivers suitable for most countries of the world and most pockets.

Radio receiver circuit design continues to improve, and one new three-speed radiogram (Ferguson) surprised music-lovers with its remarkably clear tone at the reasonable price of £65 without British purchase tax.

The great impetus given to the production of television receivers by the opening of Sutton Coldfield transmitting station in 1950 and the opening of the world's most powerful transmitter at Holme Moss (45kW) on 12th October has not interfered with the production of receiving sets for sound broadcasting services.

The range of radio receivers extends from a simple two-valve battery portable costing about £4 (Eveready) to superb sound reproducers costing several hundreds of pounds.

The portable radio set, whether powered by batteries only or of the battery-mains type is being manufactured by almost every radio-receiver maker. One new one (Pye) has a telescopic aerial. A brief-case battery model (Eveready) has been sold out for months ahead. Gay colours prevailed and a tartan-covered model (Invicta) greatly attracted women visitors.

The principal technical improvements were in chassis design and circuit refinements to reduce noise and interference. Band-spread tuning, of course, is widely used and thorough tropicalization ensures against deterioration in warm, damp climates.

Several firms showed magnetic tape-recording apparatus for use in the home, office, industry, and broadcasting. The continental interest in these machines has been even greater than the British because of their robust construction and complete reliability.

There is still an ever-increasing demand for radiograms, most of which now have the facility for long-playing records. The demand for record storage cases and cabinets is greater than ever and sheaths and record-carrying bags will shortly be on the market again.

The 12-in. television tube is now the most popular size, though two firms still manufacturing the 9 in. are doing extremely well with it. More firms showed projection models, which with their large screens, appear to be in even competition with 15 in. and 16 in. console direct-viewing models. One firm (E.M.I.) showed a set with 21 in. screen.

The principal television receiver manufacturers have received serious inquiries from countries which have started or are about to start television services: Germany, Holland, Denmark, Argentine, Brazil, and France.

The public attendance of 232,572, though lower than in 1949, was regarded as exceedingly satisfactory in view of rival attractions in the Festival of Britain. Most of the visitors had a genuine interest in the various products exhibited and came with a purpose. The registered overseas attendance was 1818—the highest yet.

Meteor Research

The survey, by radar methods, of meteor showers, velocities, and turbulence that are observed in the Southern Hemisphere will shortly commence, since the erection and installation of the radar equipment has now been completed at a site near Christchurch.

Under Government grant through the Department of Scientific and Industrial Research, a meteor research station has been established within the last twelve months by Canterbury University College at a suitable site between Rolleston and Lincoln, Canterbury. Recently an additional grant was made to the College by the Nuffield Foundation for furtherance of this research.

Correlation of data with the observations made in the Northern Hemisphere will it is hoped make a valuable contribution to this branch of astronomy. Much is yet to be discovered by fundamental research of the behaviour of these meteoric particles, their tracks in space, their speed, frequency of occurrence, and the extent of their recurrence annually.

The studies are connected with research on radio propagation because meteors form ionized trails in one of the ionospheric layers that make possible the transmission and reception of radio shortwaves around the earth. At the same time fading and variation in reception is caused by the changing in uniformity of these ionized layers of the upper atmosphere. The layers consist of particles of moving matter carrying charges of positive or negative electricity (ions) and they cause the radio waves of the higher frequencies (short waves) to be bent back to earth as a mirror reflects light rays. Various layers of such ionized clouds are now distinguished by letters of the alphabet. Meteors create ionized trails and these are generally formed in the ionospheric E region at about 60 miles above the earth.

An important centre for this work at present is in England at Manchester. Although other centres exist in the U.S.A. and Canada, the New Zealand station is the first in the Southern Hemisphere, and the studies to be made are of considerable importance in the world-wide investigations.

At Manchester eight radio transmitters and receivers have been installed; these are so sensitive that an individual meteor roughly the size of a pinhead entering the earth atmosphere over Sweden can be detected and its height, direction, and velocity (which may be 90,000 m.p.h.) automatically recorded.

Radio (1936) Ltd. Honours Service Of Its Staff

The event of the year for the employees of Radio (1936) Ltd. took place in the company's cafeteria and assembly hall in Auckland on 21st August.

The occasion was that of the distribution to employees of Length Service Badges coupled with the fitting recognition of twenty-five years since the present Managing Director, Mr. D. T. Clifton-Lewis and Mr. H. R. Jacques, guests of honour, joined the company. The hall was gay with flowers, and decorations in appropriate colours—colours which have been built into the Service Badges presented to those having served five years or more. Among those present were Messrs. W. J. Truscott, P. Harrison, R. J. Orbell, S. Tong, H. Robinson, A. J. Tutill, A. McRae, C. Haswell, E. G. Ferriday, Dr. F. Farley, G. M. Bowels, Dr. Frost, T. Evans, and G. Ferris.

The Chairman of Directors, Mr. W. J. Truscott, outlined the growth of the company from its inception in 1922. He recalled that remarkable progress had been made since the founders, including himself, decided over morning coffee some 29 years ago, to establish a radio enterprise. He expressed his appreciation, and that of the directors and shareholders, of the effort extended by long-

service employees in the building of the organization to what it is today.

Mr. Truscott presented Mr. T. D. Clifton-Lewis and Mr. H. R. Jacques with 25-year Service Badges and proposed a toast to them which was accorded a tremendous ovation. Mr. Clifton-Lewis received an exquisite bone china dessert set, and cloisonnè vases, and Mr. Jacques a silver tea service.

The main ceremony, that of the presentation of Service Badges to the staff was undertaken by Mr. Clifton-Lewis, who stated how gratified he was for the co-operation and assistance given him over the years by his colleagues, the directors, and the staff generally. He paid tribute to those who had completed long service and made mention of the success which had been achieved through the united application to work of all those recipients of the coveted service pins.

Ninety-six people received service pins, 36 of whom had over 15 years' service with the company.

Mr. Wynn James of the 20 to 25 year group, replied suitably on behalf of the badge-holders.

Subsequent toasts were proposed by Messrs. W. J. Murphy, A. J. Holmes, and A. W. Albrecht, who presented on behalf of the staff, to Messrs. W. J. Truscott, D. T. Clifton-Lewis, and H. R. Jacques, beautifully executed illuminated addresses, containing messages of goodwill from the employees.

H. R. Jacques, W. J. Truscott, and D. T. Clifton-Lewis.

Mr. P. Harrison responded to a toast to the directors proposed by Mr. W. Pearson, and the function closed wtih a delightful conversazione when associates, friends, directors, and staff enjoyed chatting amicably together.

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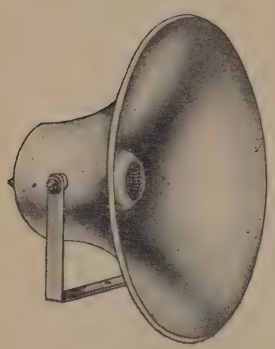
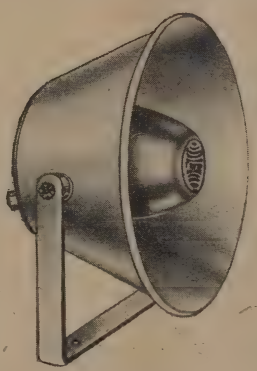


Model SD26.
"Senior" Reflex
P.A. Speaker, **without** transformer
V.C. 7.5 ohms
Response 275-8,000 c.p.s.
Capacity 10 watts.

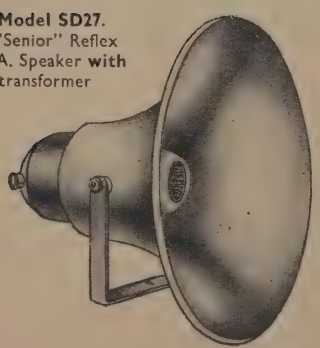
Dimensions and Weights

Model SD26 (without transformer)	
Flare diameter	15⅝ ins.
Back to front depth	10 ins.
Weight	8 lbs. 10 ozs.
Model SD27 (with transformer)	
Flare diameter	15⅝ ins.
Back to front depth	12¼ ins.
Weight	11 lbs. 4ozs.



Model SD24
"Junior" Reflex
P.A. Speaker, **without** transformer
V.C. 7.5 ohms
Response 400-7,000 c.p.s.
Capacity 5 watts

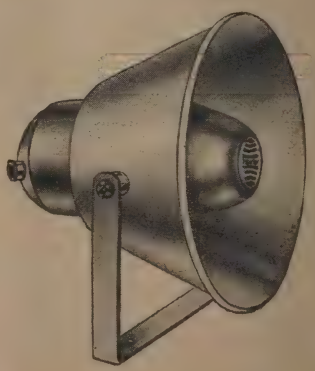
Model SD25
"Junior" Reflex
P.A. Speaker, **with** transformer



Model SD27.
"Senior" Reflex
P.A. Speaker **with** transformer

Dimensions and Weights

Model SD24 (without transformer)	
Flare diameter	10⅝ ins.
Height from bottom of bracket to top of flare	11¼ ins.
Back to front depth	6¼ ins.
Weight	8 lbs. 1oz.
Model SD25 (with transformer)	
Flare diameter	10⅝ ins.
Height from bottom of bracket to top of flare	11¼ ins.
Back to front depth	9¼ ins.
Weight	10 lbs. 6ozs.



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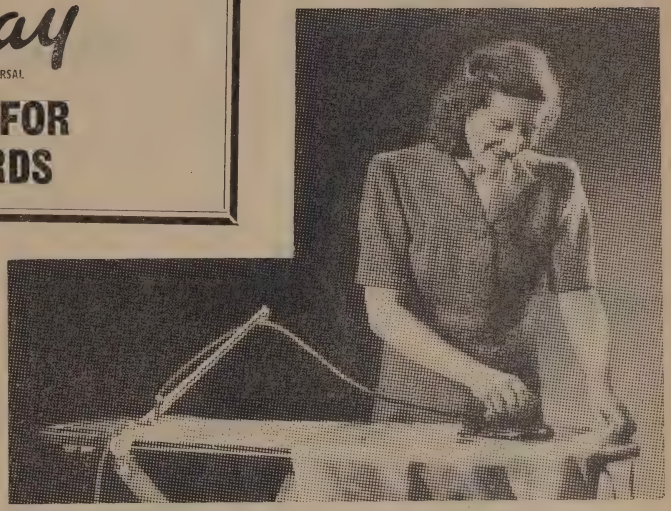

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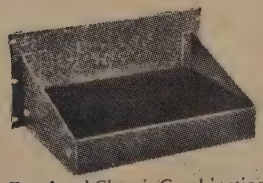

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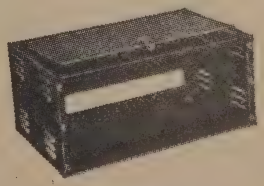

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The Virtues and Uses of Negative Feedback

The topic of this month's paper-spoiling is not how to make a downright poor audio amplifier into something you can live with, but rather how to further improve a good, soundly constructed piece of equipment. In order to obtain the full advantages of negative feedback the audio amplifier should be operating in a pleasing manner, untroubled by too much inherent hum and not prone to instabiltiy before the feedback loop is closed. This precaution will ensure that one is just not merely using degeneration for the sake of covering up a multitude of sins which good radio practice should take care of anyway, but is deriving the benefit of reduced hum content in the output and smoother frequency response than is obtainable by normal methods. Feedback will correct eccentricities occurring within that part of the circuit enclosed by the degeneration loop; it will not, however, have any effect on undesirable components of the signal voltage which is part of the input voltage to the amplifier. To explain this further, if the feedback loop includes, say, three stages such as voltage amplifier, phase inverter, and output stage, then anything added to or removed from the signal voltage as it passes through these stages will be corrected for by the negative feedback and very effectively too. Should the distortion be occurring ahead of the voltage amplifier stage, however, it will be amplified all through every stage regardless of the feedback.

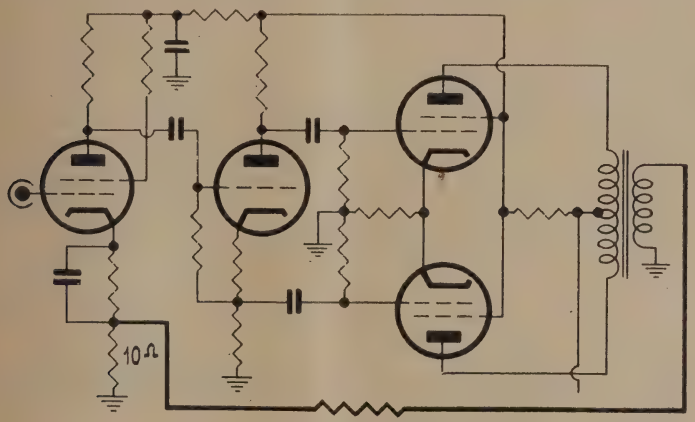

Fig. 1

Now most radio men will have heard of the "Williamson Amplifier" and many will have constructed it and marvelled mightily at the sheer smoothness of its performance, this in large measure being due to the extremely high proportion of negative feedback employed over a number of stages. For the amplifier to remain stable under these conditions has called for clever engineering and high quality construction particularly of the output transformer. In stating the amount of feedback to be employed it is usual to refer to it as so many DB., this being the output reduction in decibels when the feedback is connected and in the "Williamson" this is more than 20 db. over four stages, which takes a lot of getting indeed; but for ordinary amplifiers a figure of 4 db. is easily obtained and proves very beneficial, particularly where the output load is subject to some variation (*e.g.,* several speakers in different rooms each having an individual volume control).

Also in the case of vibrator amplifiers feedback can be used to eliminate those last traces of hash in the output.

There are various methods of wiring up a feedback loop, but that shown in Fig. 1 has most to commend it since the circuitry involved is at low impedance throughout, also no D.C. blocking condensers are used which might introduce phase shift.

The system shown in Fig. 2 works well enough but is critical in adjustment, and the loop does not include the output transformer, which arrangement is not the very best. Fig. 3 shows a means of introducing feedback to a novel type of phase inverter popularized in *Radio and Electronics* some months back. It is quite effective but the condenser in series with the line introduces some phase shift. This is not serious in cases where the degree of feedback is small but if long lines are run from the output to feed a number of different points the distributed capacity of the leads is sufficient to create oscillation. Phase shift becoming so considerable that regeneration takes place instead of degeneration.

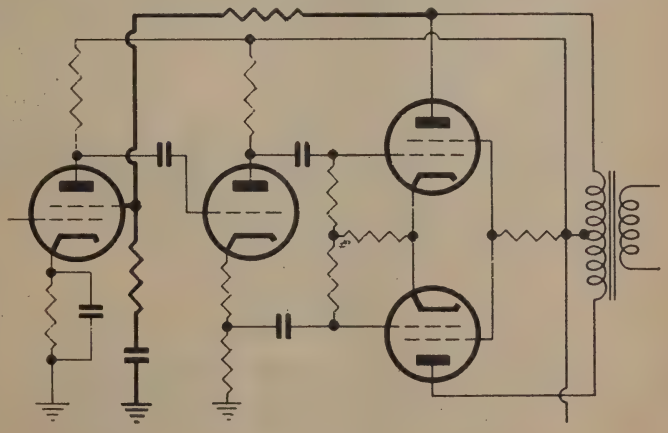

Fig. 2

A very useful and effective method of employing feedback is to make the degenerative voltage frequency discriminating whereby a bass or treble boosting effect can

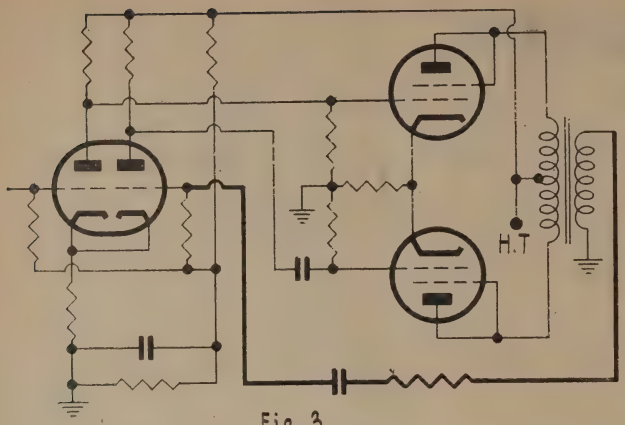

Fig. 3

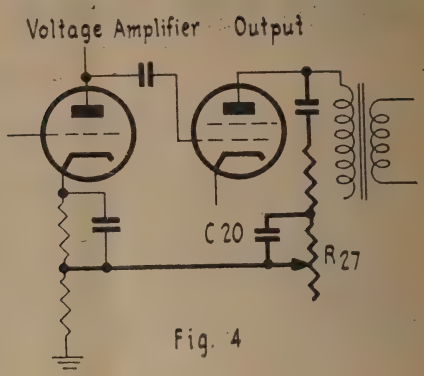

Fig. 4

be obtained. As most radio servicemen will appreciate negative feedback reduces the gain of an amplifier, but this in itself is not important since more than sufficient gain is provided for when preparing the design of the set, but should the feedback voltage be made to fall off at, say, bass frequencies then the gain of the amplifier will increase below a predetermined number of cycles. The result will be that the bass frequencies are reinforced or boosted and if this is made controllable by means of a potentiometer, a very effective bass compensator can be constructed.

In the issue of *Radio and Electronics* for March, 1948, a bass boosting control as shown in Fig. 4 was described. The condenser C_{20}, being of fairly low value, passes high frequencies readily enough but its effectiveness falls off as the audio voltage comes down in frequency with the result that the bass end gets more and more amplification the lower the frequency to be reproduced. The 2 megohm potentiometer, R_{27}, by-passes the condenser to an extent depending on its setting, so that the amount of bass lift can be controlled. Just one point about this circuit though, if you want bass it is necessary to make sure the amplifier is capable of reproducing it in the first instance, which means a reasonable sort of output transformer and speaker, otherwise you may be disappointed in the results. In short, it is most unsatisfying feeding buns to an elephant that isn't there!

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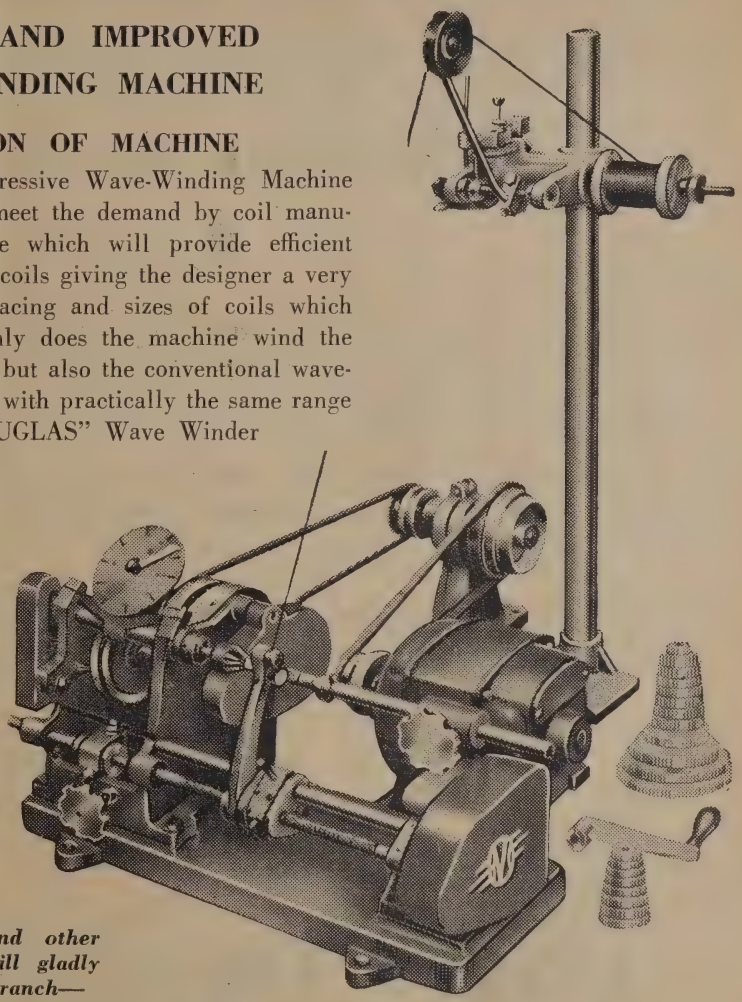

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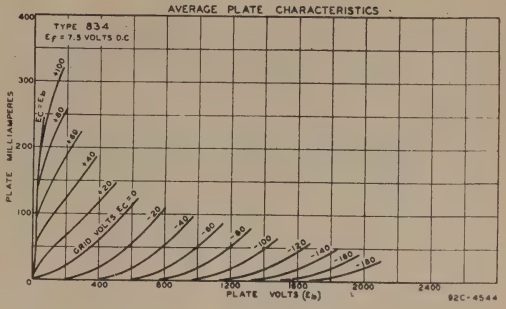
TUBE DATA: The 834 V.H.F. Transmitting Triode

The 834 is a three-electrode transmitting tube of the thoriated-tungsten filament type for use as a radio-frequency amplifier and oscillator, particularly at the higher radio frequencies. The grid and plate are supported from the top of the glass bulb by individual leads which are brought out of the tube through separate seals. This construction insures low interelectrode capacitances and minimum lead inductance. The 834 may be operated at maximum ratings at frequencies as high as 100 megacycles; it may be operated at reduced plate voltage and input up to 350 megacycles. The maximum plate dissipation for class c telegraph and class B services is 50 watts.



CHARACTERISTICS AND RATINGS

Filament voltage (A.C. or D.C.)	7.5	volts
Filament current	3.1	Amp.
Amplification factor	10.5	
Direct interelectrode capacitances:		
Grid-plate	2.6	*uuf.*
Grid-filament	2.2	*uuf.*
Plate-filament	0.6	*uuf.*
Bulb (for dimensions, see below)	S-21	
Base (for connections, see below)	Medium 4-pin, Bayonet	

MAXIMUM RATINGS AND TYPICAL OPERATING CONDITIONS

As R.F. Power Amplifier—Class B Telephony

Carrier conditions per tube for use with a max. modulation factor of 1.0.

D.C. plate voltage			1250 max.	volts
D.C. plate current			100 max.	ma.
Plate input			75 max.	watts
Plate dissipation			50 max.	watts
Typical Operation:				
D.C. plate voltage	750	1000	1250	volts
D.C. grid voltage*	—70	—90	—115	volts
Peak R.F. grid voltage	90	100	115	volts
D.C. plate current	50	50	50	ma.
D.C. grid current (approx.)†	1	0.5	0	ma.
Driving power (approx.)†‡	3.3	3.1	3	watts
Power output (approx.)	11	16	20	watts

As Plate-Modulated R.F. Power Amplifier—Class C Telephony

Carrier conditions per tube for use with a max. modulation factor of 1.0.

D.C. plate voltage			1000 max.	volts
D.C. grid voltage			—400 max.	volts
D.C. plate current			100 max.	ma.
D.C. grid current			20 max.	ma.
Plate input			100 max.	watts
Plate dissipation			35 max.	watts
Typical operation:				
D.C. plate voltage		750	1000	volts
D.C. grid voltage:				
From a grid resistor of		14500	18000	volts
From a fixed supply of		—290	—310	ohms
Peak R.F. grid voltage		415	435	volts
D.C. plate current		90	90	ma.
D.C. grid current (approx.)†		20	1.75	ma.
Power output (approx.)		42	58	watts
Driving power (approx.)†		7.5	6.5	watts

As R.F. Power Omplifier and Oscillator—Class C Telegraphy

Key-down conditions per tube without modulation§

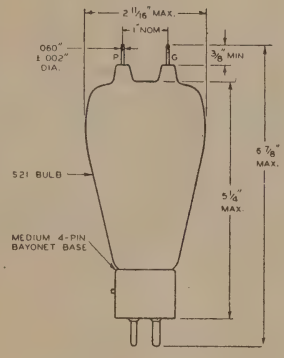
D.C. plate voltage			1250 max.	volts
D.C. grid voltage			—400 max.	volts
D.C. plate current			100 max.	ma.
D.C. grid current			20 max.	ma.
Plate input			125 max.	watts
Plate dissipation			50 max.	watts
Typical Operation:				
D.C. plate voltage	750	1000	1250	volts
D.C. grid voltage:				
From a fixed supply of	—175	—200	—225	volts
From a cathode resistor of	1600	1860	2150	ohms
From a grid resistor of	8800	11400	15000	ohms
Peak R.F. grid voltage	300	325	350	volts
D.C. plate current	90	90	90	ma.
D.C. grid current (approx.)†	20	17.5	15	ma.
Driving power (approx.)†	5.5	5	4.5	watts
Power output (approx.)	42	58	75	watts

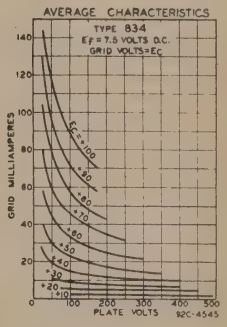
*Grid voltages are given with respect to the mid-point of filament operated on A.C. If D.C. is used each stated value of grid voltage should be decreased by one-half the filament voltage and the circuit returns made to the negative end of the filament.

†Subject to wide variations depending on the impedance of the load circuit. High-impedance load circuits require more grid current and driving power to obtain the desired output. Low-impedance circuits need less grid current and driving power, but plate-circuit efficiency is sacrificed. The driving stage should be capable of delivering considerably more than the required driving power.

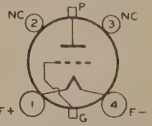
‡At crest of audio-frequency cycle with modulation factor of 0.1.

§Modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115 per cent. of the carrier conditions.





Bottom View of Socket Connections



Pin 1 – Filament
Pin 2 – No Connection
Pin 3 – No Connection
Pin 4 – Filament
P = Plate
G = Grid

INSTALLATION

The base of the 834 fits the standard four-contact socket, such as the UR-542-A, which should be installed to hold the tube in a vertical position with the base either up or down. The filament terminals are connected to the two large base pins; the grid and plate leads are brought out through separate seals at the top of the bulb (for connections, see below).

Connections to the grid and plate terminals must be flexible enough so that normal expansion will not place a strain on the glass at the seals, yet heavy enough to carry the high circulating R.F. current. Each lead wire should be connected to its terminal clamp before the clamp is placed on the terminal tip. The clamp should be slightly sprung so that it can easily be slipped over

its terminal. Connections should never be soldered directly to the tube terminal tips as the heat of the soldering operation may result in the cracking of the lead seals. The tube terminal tips should not be used to support circuit parts.

The bulb becomes very hot during continuous operation of the tube so that free circulation of air around the tube should be provided. When the 834 is operated at frequencies higher than 60 mc/sec., forced cooling of the tube is recommended. This may be done by means of a small electric fan which directs air against the middle and upper sections of the bulb. Under any condition of operation the maximum bulb temperature should not exceed 175C.° (347°F.) as measured by a thermometer placed against the glass at the top of the tube, midway between the grid and plate leads. The installation of all wires and connections should be made so that they will not be close to or touch the bulb in order to avoid puncture of the glass due to peak voltage effects.

The filament of the 834 is of the thoriated-tungsten type. The filament voltage should not vary more than ± 5 per cent. from the rated value; otherwise, a loss of emission may result. It is recommended that, in intermittent service where the average number of daily transmissions is greater than 100, the filament be maintained at 80 per cent. of normal voltage during standby periods. If the number of transmissions is less than 100 per day, the filament power during standby periods may be either maintained or removed, whichever is preferred. However, in applications where the average number of transmissions is usually not greater than 100 and where the standby periods are usually no longer than the transmission periods, the filament voltage may be maintained at normal value during standby periods. The filament of the 834 should be operated at constant voltage rather than constant current and should be allowed to reach normal operating temperature before other voltages are applied.

The plate of the 834 shows a dull red colour at the maximum plate-dissipation rating for each service.

Overheating of the 834 by severe overload may decrease its filament emission. Filament activity can sometimes be restored by operating the filament at rated voltage for ten minutes or more with no voltage on the plate or grid. This process may be accelerated by raising the filament voltage to 9 volts (not higher) for a few minutes. The positive plate-supply lead should be provided with a protective device such as a high-voltage fuse. This device should instantly remove the plate voltage when the D.C. plate current reaches a value 50 per cent. greater than normal.

In order that the maximum ratings given under Characteristics will not be exceeded, changes in plate and filament voltages due to line-voltage fluctuation, load variation, and manufacturing variation of the associated apparatus, must be determined. An average value of plate and filament voltage should then be chosen so that under the usual voltage variations the maximum rated voltages will not be exceeded.

When a new circuit is tried or when adjustments are made, it is advisable to reduce the plate voltage. This may be done conveniently by means of a resistance of about 5000 ohms connected in series with the high-voltage plate lead during the adjustments. *The rated plate voltage of this tube is high enough to be dangerous to the user. Care should be taken during the adjustment of circuits, especially those in which the exposed circuit parts are at high D.C. plate potential.*

APPLICATION

In class B R.F. service, the 834 may be supplied with bias from a battery, from a rectifier of good regulation, or from a cathode resistor, suitably by-passed for audio and radio frequencies.

In plate-modulated class C R.F. service, the 834 may be supplied with grid bias from a grid leak, or from a combination of grid leak and fixed supply, or grid leak and cathode resistor. The cathode resistor should be suitably by-passed for A.F. or R.F. The combination method of grid leak and fixed supply has the advantage of not only protecting the tube from damage through loss of excitation but also of minimizing distortion by bias-supply compensation.

In class C R.F. telegraph service, the 834 may be supplied with grid bias by any convenient method. When the 834 is used in the final amplifier or a preceding stage of a transmitter designed for break-in operation and oscillator keying, a small amount of fixed bias must be used to maintain the plate current at a safe value. With plate voltage of 1250 volts, a fixed bias of at least 90 volts should be used.

The 834 may be operated at maximum ratings at frequencies as high as 100 megacycles. The tube may be operated at higher frequencies provided the maximum values of plate voltage and power input are reduced as the frequency is raised (other maximum ratings are the same as shown under Characteristics). The tabulation below shows the highest percentage of maximum plate voltage and power input that can be used up to 350 mc/sec. *Special attention should be given to adequate ventilation and the maintenance of normal ambient temperatures at these frequencies. See Installation.*

Frequency	100	170	350	Mc.
Max. permissible percentage of max. rated plate voltage and plate input:				
Class B R.F.	100	89	73	per cent.
Class C plate-modulated	100	80	53	per cent.
Class C telegraphy	100	80	53	per cent.

When more R.F. power output is required than can be obtained from a single 834, the push-pull or the parallel connection may be used. For example, two tubes connected in push-pull or in parallel will give approximately twice the power output of one tube. The parallel connection requires no increase in exciting voltage; the push-pull connection requires twice the R.F. excitation voltage necessary to drive a single tube. With either connection, the driving power required is approximately twice that for single-tube operation while the grid bias is the same as that for a single tube. The push-pull arrangement has the advantage of simplifying the balancing of high-frequency circuits and of cancelling the even-order harmonics from the output.

If parasitic oscillations occur in the parallel or the push-pull circuits, they can often be eliminated by connecting a non-inductive resistor of 10 to 100 ohms in series with each grid lead, as close to the grid terminal as possible.

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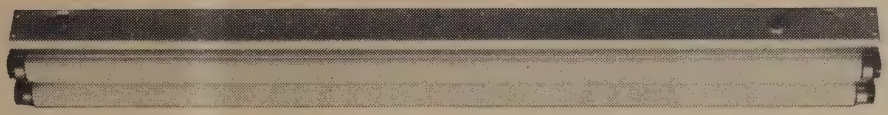

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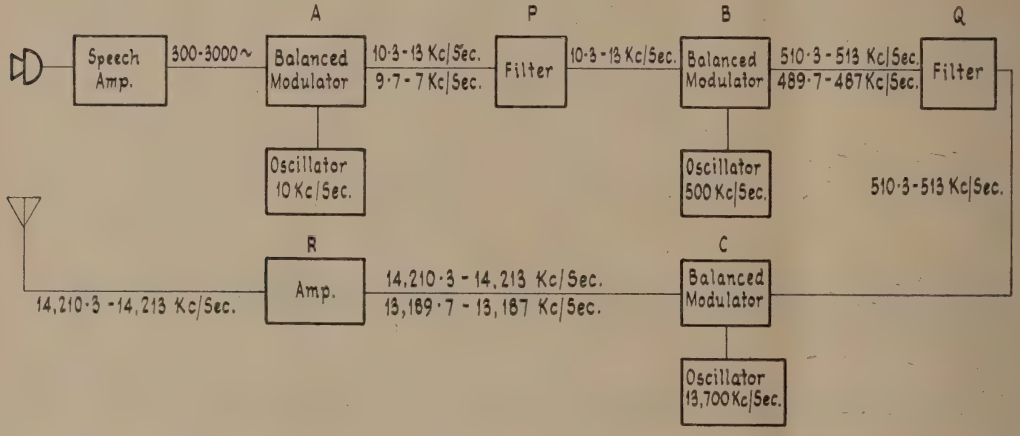
The PHILIPS Experimenter

No. 49: How S.S.S.C. Is Produced

In Experimenter No. 48 we had something to say about the advantages theoretically to be gained by using S.S.S.C. transmission in place of conventional A.M. This month we hope to show in as simple and straightforward a way as possible, what the two basic methods are for producing single-sideband transmissions, and how they work. In tackling any new radio technique, it is essential to commence by obtaining an understanding of the principles underlying what is being attempted, before any practical approach is made. This remark applies with more than ordinary force to S.S.S.C., because the equipment is inherently more complex than that belonging to the more familiar modulation methods, so that any attempt to make some S.S.S.C. gear work, without a clear idea on the part of the operator of just what he is trying to accomplish, is almost doomed to failure. The construction of the equipment will not be found difficult by any amateur who has built his own transmitters or receivers, but its initial adjustment might be found so if he is not in possession of certain basic facts. On the other hand, the possessor of those facts will find the setting up and operation of the equipment no more difficult than that of any other sort of transmitter.



THE BRUTE FORCE METHOD OF GENERATING S.S.S.C.

Perhaps a more elegant term for the first method we are to describe would be the "indirect" method. It may use "brute force," as indicated, but certainly not ignorance!

Most of us have at least read about a circuit known as the balanced modulator, even if we have had no occasion to use one, and it is the one circuit trick, above all others that makes S.S.S.C. a practical proposition. Its high-sounding title need not scare anyone off, however, because it is nothing more than a special kind of push-pull circuit. Imagine, for a start, that we have a perfectly normal push-pull amplifier, with transformers at the input and output. In order to transform this into a balanced modulator, all we have to do is to feed it with two input signals instead of the more usual one, with the proviso that the signals must be applied, and the output taken off, in a specified manner. We will suppose that one of the signals, which we can call the carrier frequency, has a much higher frequency than the other, which we will call the modulation frequency. The modulation frequency is applied in push-pull via the primary of the push-pull input transformer, and the output is taken off from the secondary of the push-pull output transformer. The carrier, on the other hand, is applied to the grids of the valves in parallel, and this can be done by lifting the centre-tap of the input transformer from its normal ground, and applying the carrier at this point. With this connection, it is clear that the carrier frequency is balanced out in the primary of the output transformer, just as is the second harmonic distortion in a push-pull audio amplifier. The modulation frequency, however, beats with the carrier to produce the sidebands ($f_c + f_m$), and ($f_c - f_m$). The action of the circuit is such that these are not balanced out by the push-pull connection, so that both of them appear in the output.

If the carrier is a radio frequency, and the modulation an audio frequency, the input transformer would have to be an audio transformer, while the output transformer would be an R.F. transformer, tuned to the carrier frequency, and so capable of passing the sidebands, whose frequencies are so close to the carrier frequency. The circuit does, of course, produce other frequencies than the sidebands, namely the second harmonics of both the carrier and the modulating frequencies, but the tuned output transformer sees to it that none of these additional frequencies are able to appear in the output.

Now in producing an S.S.S.C. signal, we want to remove the carrier and one sideband. The first step, therefore, is to perform the modulation in a balanced modulator circuit, such as we have been describing.

This automatically removes the carrier, and leaves an output signal consisting of both sidebands. The problem remaining is thus to remove one of these, leaving only the other. This, too, is where the difficulty comes in, as a moment's thought will show. Suppose, for example, that we want our final S.S.S.C. signal to be on the 80m. amateur band. We build our balanced modulator, and very readily get a double-side-band-suppressed-carrier signal. But how are we to remove the unwanted side-

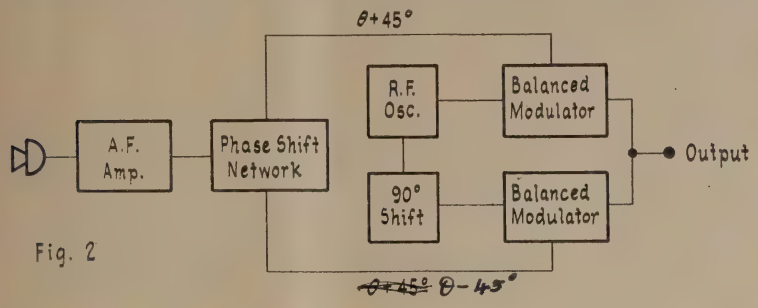


Fig. 2

band? If, as an illustration, the modulating frequency is 300 c/sec., as being the lowest speech frequency it is necessary to transmit, we find ourselves trying to separate two radio frequencies near 3750 kc/sec. *but only* 500 *cycles apart*. This would be a difficult job even for a crystal filter, but when it is remembered that our speech is a band of frequencies, from 300 to 3000 c/sec., and that our filter must have a flat pass band over this range, while giving very strong attenuation to a similar band only 500 cycles away, we begin to realize that we have an almost impossible job on our hands. No doubt a filter passing 3750.3 to 3753 kc/sec., while strongly suppressing all other frequencies (by at least 40 db.) could be built, but it would be horribly expensive, and would have the very grave disadvantage that it would not be possible to QSY inside the band. Ordinary tuned circuits would be quite out of the question for getting the sort of selectivity that would be required. At this point, the theory of filters comes to the rescue. It is quite possible, and relatively easy, to make filters which have the required characteristics, but which work at lower frequencies. For example, if we take as our carrier a frequency of 10 kc/sec., and modulate this with our speech band from 300 to 3000 c/sec., the sidebands will be 10.3 to 13 kc/sec., and 9.7 to 7 kc/sec. A band-pass filter can now be constructed which will pass either of these bands, while very strongly attenuating all other frequencies. If this is done, we have our single sideband. The only trouble is that it is not on the frequency at which we want to transmit it. Suppose now that we take another carrier considerably higher in frequency—say 500 kc/sec. In a second balanced modulator we eliminate this carrier, but produce sidebands whose frequencies are 510.3 to 513 kc/sec., and 489.7 to 487 kc/sec. This time, the sidebands are approximately 20 kc/sec. apart instead of only 500 c/sec., so that although the new carrier frequency is much higher, it is still possible to make a filter that removes one of the sidebands, and passes on the other. However, we are still not at our desired transmission frequency. Now, though, if we do the balanced modulator trick a third time, the sidebands will be spaced by over a megacycle, and it will be possible to separate them by means of a simple tuned circuit. Accordingly, we make the carrier for the third balanced modulation equal in frequency to the desired output frequency. The single sideband output is now on the final transmission frequency, and can be amplified until the power level is up to the required transmitted power.

The whole scheme of the above method is illustrated in Fig. 1, which shows the upper sideband being selected in each case, and gives the frequencies that are selected and rejected, respectively. Although this method obviously needs a multiplicity of stages, it is very simple in principle, since it consists only of the basic method of balanced modulation, followed by sideband selection, carried out three times in succession. All operations can be carried out at powers of only a fraction of a watt, so that transmitting tubes and higher powered stages occur in the transmitter only after the S.S.S.C. signal has been generated.

THE PHASING METHOD

The chief disadvantage of the brute force method from the amateur point of view is that the low-frequency filters are difficult to make without access to laboratory measuring equipment. In the U.S.A., these sideband filters are available as built-up units, thereby removing at one stroke the chief practical difficulty encountered when applying the method. Also, sideband filters tend to be rather on the expensive side, so that there is still room for an alternative method of generation of the S.S.S.C. signal. Luckily, such a method is available. Its fundamental structure is illustrated in Fig. 2. The only really satisfactory way of explaining its operation is by the use of mathematics, which are rather out of place in these articles, but luckily, it is only necessary to know what each part of the arrangement is expected to do in order to build and adjust it. The heart of the system is a *pair* of balanced modulators. It can be proved both mathematically, and in practice, that if these two balanced modulators are fed in the way shown in Fig. 2, and at the same time have their outputs added together in a common load circuit, the output consists of a single sideband. Each balanced modulator is fed from the same audio and R.F. sources, with two important differences. The R.F. voltages feeding the modulators must differ in phase by 90°, and similarly, the audio signals fed to the two modulator circuits must also differ in phase by 90°. In the case of the R.F., this phase difference is very easily arranged, and, if the audio modulation consisted of a single tone of fixed frequency, it would likewise be easy to arrange for the required phase difference between the two audio signals for the modulators. Unfortunately, however, it is not at all easy to make two audio channels in which a phase difference of 90° exists *over the whole audio range, irrespective of frequency*. Indeed, until a very few years ago, it was not possible, and it was only the invention of Dome, in America, of several types of wide-band phase shift networks, that made this method of single-sideband generation possible for a band of A.F. rather than for just a single frequency.

It is not very difficult to see how the system works. Each balanced modulator produces a double-sideband, suppressed-carrier signal quite independently of the other. It is found, however, that if the signals to the modulators are phased as shown, one sideband from one of the modulators is exactly out of phase with the corresponding sideband from the other, so that when their outputs are added, these sidebands cancel each other, and do not appear in the output. By the same token, the remaining sidebands are exactly in phase, and add together in the common output circuit. Since each modu-

(Continued on Page 33)

1951 Annual Conference

N.Z. Radio and Television Manufacturers Federation

Held at Wairakei on 27th and 28th September, with an attendance of 22 delegates, this conference was voted an outstanding success, not only for the valuable contributions made by delegates to the solution of many major problems facing the industry, but also for the spirit of co-operation and congeniality which was so evident throughout the conference.

In attendance were the following: Messrs. T. J. F. Spencer, Akrad Radio Corporation, Ltd.; R. Slade, Philips Electrical Industries of N.Z., Ltd.; D. C. Wishart, Beacon Radio, Ltd.; T. P. Wills, Autocrat Radio Ltd.; W. I. Cunninghame, H. W. Clarke (N.Z.), Ltd.; J. S. Burns, Collier & Beale, Ltd.; N. Souper, Philips Electrical Industries of N.Z., Ltd.; L. H. Wright, His Master's Voice (N.Z.), Ltd.; J. S. Oxley, Swan Electric Co., Ltd.; D. B. Billing, Turnbull and Jones, Ltd.; H. W. Henderson, Radio Corporation, Ltd.; W. J. Meaghan, Sheffield Radio Ltd.; D. P. Joseph, Industrial Electronics, Ltd.; T. R. Gobby, Dominion Radio, Ltd.; J. Carpenter, National Carbon Pty., Ltd.; G. A. Wooller, G. A. Wooller & Co., Ltd.; H. R. Jaques, Radio (1936), Ltd.; D. T. Clifton-Lewis, Radio (1936) Ltd., G. S. Benson, Autocrat Radio Ltd.; W. D. Foster, Radio and Electronics (N.Z.), Ltd.; B. W. Bookman, Goldberg Advertising Ltd.; C. H. Roser, Radio and Electronics (N.Z.), Ltd.; W. Somerville, Secretary, New Zealand Radio and Television Manufacturers Federation.

Incorporated in a large agenda paper were ten remits from associations and it speaks well for the chairman's handling of the meeting that the full list of items was dealt with in the short time available without restriction of full discussion.

In his welcome to the delegates, President Tom Spencer paid tribute to those present for their keenness in coming so far to attend the conference. In accepting apologies for several prominent members, Mr. Spencer regretted the absence through indisposition of the immediate Past President, Mr. Wm. Blackwell, and of the executive member, Mr. P. C. Collier. Other apologies were from Mesrs. Larsen, Shiel, Webb, Mountjoy and Westco Ltd. A welcome was extended to visitors from the publicity section, namely Messrs. W. D. Foster and C. H. Roser, representing the industry's official journal, *Radio and Electronics,* and Mr. B. W. Bookman (Goldberg Advertising, Ltd., Auckland), the Federation's Liaison Officer.

The Annual Report, which was read and adopted, outlined the executive's action in the large number of matters dealt with during the year, and the income and expenditure account revealed that the Federation was in a very sound position financially.

TRAINING FOR TV SERVICE

A discussion was held on the question of whether sufficient educational facilities existed for the training of personnel to meet the demand that would exist when TV arrives in this country. Reference was made to instruction available from certain technical colleges and recent newspaper articles on the subject were discussed.

Delegates were unanimous that the Federation should support any body prepared to provide educational facilities for the electronics industry, but pointed out that the subject also covered the problem of the training of apprentices. This problem was not yet settled, although it was expected that a report would be made by a committee in about six months' time. It was finally resolved that the Federation support the technical colleges' electronics instructional schemes for radio personnel provided that they do not at this stage conflict with the Federation's plans for training apprentices.

IMPORT CONTROL

In view of the possibility of the Board of Trade's considering proposals for new tariffs on certain imports which are to be freed from control and which would affect the industry, the conference considered at length ways and means of protecting the present manufacturing and selling set-up. In view of the unlikelihood of the Board of Trade making any pronouncement for some time, it was decided to empower the incoming executive to engage expert advice and to prepare a case on behalf of the Federation for submission to the Board of Trade at the appropriate time.

In regard to token licenses some members thought that more restriction should be applied but others felt that such quantities of completely made receivers as came into New Zealand under token license were doing no harm. It was, however, decided that the conference support the decision arrived at at last year's annual meeting, in which it laid down its policy of opposing free imports of built-up receivers.

GENERAL OVERSEAS SUPPLY POSITION

The problem of the shortage of non-ferrous metals was causing great concern to manufacturers; especially was brass in short supply, and of copper wire there appeared to be no source of supply at present. It was decided to make representation to the appropriate Government Department to urge United Kingdom authorities to assist the release to individual New Zealand manufacturers of winding wires and other non-ferrous metals when shown to be available ex U.K.

SPEAKERS

Regarding the question of imports of loudspeakers, after discussion of an interchange of correspondence with the Department of Industries and Commerce, it was felt that the status quo should be undisturbed at the moment, the onus being on the local producers to show availability of supply, but a motion was carried that the Department of Industries and Commerce be advised that licenses for oval speakers be granted until such time as local manufacturers can meet the demand. Mr. Oxley, representing Swan Electric Co., Ltd., advised that size 6 in. x 4 in. ovals would be available from his company at the end of the year.

CAR SETS IMPORTED WITH CARS

In view of the fact that the Customs Department had advised that no restrictions were placed on the importation of auto sets when built into completely assembled cars and that such a receiver was regarded as part of the car equipment, it was felt that with the growth of completely assembled car imports, the volume of auto sets coming into the country would constitute a hardship to local manufacturers and that it was an unfair practice to permit the free import. It was resolved that the incoming executive take action by way of letter to the Minister of Customs giving the Federation's reasons for asking prohibition of imports.

V.H.F. EQUIPMENT

Some objection was made by members to Government Departments importing V.H.F. equipment, thus cutting into the local manufacturers' business which normally could compete, but for the fact that local products were subject to sales tax, as against the Government direct imports being exempt. It was resolved that endeavours should be made to protect local manufacturers of V.H.F. mobile R.T. equipment and the associated base station equipment, such protection to be given by implementing the existing regulations. It was not intended by the Federation that material for aviation or military purposes be included in the protection asked for.

ROYALTIES

During the discussion on the patents and royalties question the matters of ARTS & P stickers on imported auto receivers was mentioned, it being stated that royalties would be paid at the source of supply and again on arrival at New Zealand. The matter is to be taken up with ARTS & P. It was reported that negotiations were in train for a new patents agreement on the basis of 1/- per cathode-anode stream for sound broadcasting receivers only, the agreement to be for three years. In regard to royalties on television sets as and when they become operative, it was thought that some special agreement would be sought regarding royalty fees and the incoming executive would be asked to watch the interests of manufacturers in this matter.

PUBLICITY

In expressing appreciation for the attendance of Messrs. W. D. Foster and C. H. Roser of *Radio and Electronics*, the chairman asked that greater use of the magazine be made for publicizing Federation activities, and although much material discussed at meetings was not for public gaze, it was desirable that certain proceedings should be given wide publicity. It was decided that the secretary through the executive should provide the necessary copy for the magazine. Mr. Foster spoke on past happy co-operation and assured the meeting of his organization's full support in matters of mutual interest. The meeting re-affirmed its desire that *Radio and Electronics* be the official journal of the Federation.

Mr. B. W. Bookman of Goldberg's Advertising Ltd., Auckland, in the capacity of Press Liaison Officer, spoke of the value of close co-operation with the executive in

Emidisc

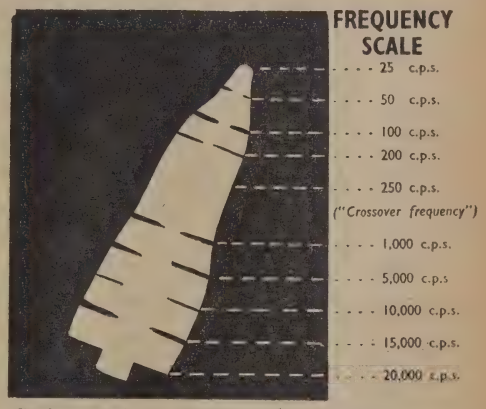
TRADE MARK

LACQUER RECORDING BLANKS

The "Emidisc" lacquer recording blank fulfils the requirements the most exacting standards of Broadcasting Authorities, Film and Professional Recording Studios. It may be used with confidence by the critical professional recording engineer and by the owner of the most modest equipment.

Accurate engraving to the limits of the recording equipment is ensured by these essential qualities and characteristics.

- SUPERIOR UPPER FREQUENCY RESPONSE. Will record up to 20,000 c.p.s. with appropriate recording equipment.
- LOW NOISE LEVEL. Average figures: — 45 db. ref. level 1 cm. per sec. velocity: — 63 db. ref. level 8 cm. per sec. velocity. (Cut at 78 r.p.m., 9½ in. diameter using sapphire cutter with 16 micron bevel.)
- ANTI-STATIC. Easy swarf clearance with brush or low-power suction systems.
- LACQUER THICKNESS constant over whole recording area.



Buchmann & Meyer pattern of a gliding tone, 20 Kilocycles to 25 cycles recorded by E.M.I. Studios Ltd., on an Emidisc blank.

GOOD WEARING QUALITIES.

PROCESSING: Mirror-like surface ensures ideal condition for processing (on appropriate sizes of blanks).

PACKED IN HERMETICALLY-SEALED METAL CONTAINERS. Ensures good shelf life and protection. 10 in. sizes and upwards have individual air separation of blanks.

Write for particulars to:

Types and sizes available for all purposes.

GREEN LABEL "Standard" selected direct recording blank: 6, 10, 12, 16 in. sizes.

YELLOW LABEL "General Purpose" direct recording blank: 10, 12, 16 in. sizes.

PLAIN LABEL "Audition" direct recording blank for experimental and general testing work: 10 in. and 12 in. sizes.

SILVER LABEL "Process." The blank for processing: 11, 12, 13, and 17 in. sizes.

Manufactured in Great Britain under exclusive licence from Pyral S.A.R.L., France

HIS MASTERS VOICE (N.Z.) LTD.

C.P.O. BOX 296 162–172 WAKEFIELD STREET, WELLINGTON, C.1.

having urgent news published, and to avoid delay in having to call executive members together for approval of publicity articles.

In regard to advertising generally, Mr. Bookman stated that he regarded certain fields still untouched for sales. It would be possible to secure statistics on the number of sets per home, segregated into certain classes, and this would give a picture of what might yet be expected in the way of sales. The survey could be prepared to show the type, age, model, table or console, etc., all of which would give a lead to types for production and for special sales drives. There appeared to be a gap in the knowledge by the trade of the actual uses of its products and some statistics as indicated would be of great value.

Mr. Bookman was asked to continue his study of the situation and submit a workable proposal to arrive at certain statistics as outlined. He was accorded a hearty vote of thanks for his gratuitous service to the Federation.

TELEVISION

The Federation, said the Chairman, had made representations to the Minister of Broadcasting for the inclusion of one of the Federation members on the inter-departmental television committee, but without avail, although the Minister has promised that any TV matters concerning the industry will be conveyed to the Federation. This is considered by the executive to be unsatisfactory. The two N.Z.B.S. engineers now overseas to study TV and its application should shortly be returning and the Executive proposed to keep well in touch with the N.Z.B.S. for such information as can be disclosed resulting from this visit. Meanwhile the Federation through the executive, will press for the establishment of a pilot station and for early determination of standards.

RADIO INTERFERENCE

After efforts by the Federation, a standing committee for interference investigation has been set up, to which the Federation was asked to nominate a member. Mr. P. C. Collier has filled this position and recently gave an excellent report covering the past year.

Much discussion took place as to why the Post and Telegraph Department, although it had wide powers, did not implement its authority often enough and rather seemed to ignore interference caused through public utilities. It was considered that the printed complaint form was too involved and should be made simpler for the public to fill in.

It was resolved that a letter of thanks be sent to the appropriate Minister for setting up the interference committee and at the same time ask that the committee adopt British standards for noise suppression. It was decided that a letter be written to the Post and Telegraph Department stating that the conference requests more positive action in the matter of noise suppression.

DEFENCE PRODUCTION

Mr. R. Slade and Mr. P. C. Collier, both members of the Federation Executive and recently appointed as advisory panel for the industry on the Joint War Production Committee, reported that informal talks had taken place with Joint Services Committee, which had been in touch with United Kingdom authorities on ways and means by which the New Zealand radio industry could assist in defence production. At present no plans had been formulated, but the Federation would be called upon when discussions with the United Kingdom were more advanced. Appreciation was expressed for the efforts of Messrs. Collier and Slade for their work on the committee and it was made a recommendation that the incoming executive should co-operate with them in the matter.

INDUSTRIAL UNION OF EMPLOYERS

Messrs. J. S. Burns and N. Souper, co-opted members, reported on the formation of the North Island Radio Manufacturers' and Assemblers' Industrial Union of Employers, which will be of value in connection with arbitration and conciliation matters and which can initiate proceedings if desired for new awards, amendments, etc. The formation of the Radio Apprentice Committee is the next step to be taken so that the industrial matters concerning the radio industry will then be firmly based. A motion of thanks was passed to Messrs. Burns and Souper.

GENERAL

A small amount of the general business was disposed of, after which Mr. T. J. T. Spencer ,in thanking delegates for their earnest attention during the two crowded days of full discussion, gave special thanks to Mr. Slade who had carried out the conference arrangements in his absence.

ELECTION OF OFFICERS

Mr. J. T. F. Spencer was re-appointed President by unanimous vote and by acclamation, and Mr. Slade was similarly re-elected.

President: Mr. T. J. F. Spencer.
Vice-President: Mr. R. Slade.
Executive: Messrs. P. C. Collier, W. I. Cunninghame, D. T. Clifton-Lewis, T. R. Gobby.
Treasurer: Mr. W. I. Cunninghame.
Publicity Officer: Mr. R. Slade.

A LECTURE

During the second day's afternoon recess, Mr. D. T. Clifton-Lewis delivered an address on staff relations work and its application in his organization, Radio (1936) Limited. This was a most interesting address, and it is hoped to publish a full report of it in an early issue of *Radio and Electronics.*

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ARCOLECTRIC will make it
New Zealand Agents
GREEN & COOPER LTD. WELLINGTON.

Yesterday a manufacturer asked for a quantity of valves short-stocked in New Zealand. Today a rush order leaves the A.W.V. Radiotron factory in Sydney. Before the week-end the manufacturer has the wanted Radiotrons.

As every radio man knows Radiotrons give utterly dependable service in operation. To this service add a supply-service that no other valve can match, firstly—through the network of Radiotron dealers throughout New Zealand, secondly—through the eight branches of N.E.E.Co. as distributors, lastly and most importantly, through the A.W.V. Radiotron factory only eight aero hours away in Sydney.

FOR SERVICE IN OPERATION AND SERVICE IN SUPPLY YOU CAN DEPEND ON RADIOTRONS.

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New Zealand Distributors:

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The "Radio & Electronics" Abstract Service

ANTENNAE AND TRANSMISSION LINES

An indoor TV aerial—this was in the form of a folded dipole, with director and reflector, and as it avoids a structure above the roof has much to be favoured. The methods of erection and feeding are given.

—*Electronic Engineering* (En.g), July, 1951, p. 262.

The high-pass properties of a wave-guide are combined with the low-pass properties of a corrrugated surface which in this design is in the form of a length of plastic material. The corrugated section is incorporated in the wave-guide as a filter and is a novel means of obtaining the filtering required.

—*Electronics* (U.S.A.), July, 1951, p. 117.

AUDIO EQUIPMENT AND DESIGN

From the mass of material on how to obtain "high fidelity" and pleasant music at the same time has been chosen 74 points which are important to keep in mind. This is indeed a useful summary.

—*Audio Engineering* (U.S.A.), June, 1951, p. 20.

A U.S. Patent (No. 2,536,644) has been obtained for recording two sound tracks in the same groove of the same side of a record. The process involves the use of the heterodyning of one train of waves with an oscillator and recording the sideband in the groove out of the audio range of the second programme. By a reversal of process stereoscopic sound production is claimed.

—*Ibid*, p. 2.

Another interesting patent is U.S. No. 2,542,594 which envisages the use of modulated supersonic sound waves for directing sound to those who want it and sparing those who do not. Reception is by way of a demodulating device for the individual listener.

—*Ibid*, p. 3.

Drive systems for magnetic recording—the first problem is a uniform speed for the wire or tape and the article outlines the method of meeting this problem.

—*Radio and Hobbies* (Aust.), Aug. 1951, p. 31.

CIRCUITS AND CIRCUIT ELEMENTS

Cathode-followers as low-noise input stages. A little used modification of the conventional cathode-follower circuit can give a much improved performance. The grid-leak resistor is made much higher than usual and the input and output impedances are independent of frequency.

—*Electronic Engineering* (Eng.), July, 1951, p. 270.

Pulses as short as millimicroseconds can be viewed or recorded by the use of high-gain distributed amplifiers. This is an important advancement on other methods wherein two artificial transmission lines are connected separately to plates and grids of the amplifier tubes which become part of the lines, the pulse currents arriving at the end of the line simultaneously. This avoids paralleling tube capacitances with greatly improved performance.

—*Electronics* (U.S.A.), July, 1951, p. 107.

ELECTRONIC DEVICES

In enlarging photographs the test exposure is a time-consuming nuisance. The light meter described to avoid this uses an RCA 5582 phototube, a 7N7 and an OB3/VR90, although almost any photocell is suitable. The microammeter is calibrated directly in seconds.

—*Radio and Television News* (U.S.A.), August, 1951, p. 60.

An electronics device referred to as "The Judgment Box" is described which is capable of taking the weighted mean of a number of quantities. Six positions on a switch represent "Strongly For," "Against," or "Neutral" for the particular factor related to the channel. An "Urgency" control is also provided and by assessing the value of the various factors, and working the switches, the machine gives the summation.

—*Electronic Engineering* (Eng.), July, 1951, p. 256.

Aspects of electrical computing, continued from the previous issue. Examples are given of multiplication, finding reciprocals, division, multiplication and addition, target following and laying, vector addition, differentiation and integration, and harmonic analysis.

—*Ibid*, p. 264.

Auxiliary circuits for the pH meter. The article describes the circuits necessary to enable the meter to read pH directly with methods of calibration.

—*Ibid*, p. 272.

INSTRUMENTS AND TEST GEAR

A unique one-tube device which will form narrow pulses from an applied sine wave—an unsymmetrical series diode clipper is employed and many uses for this simple instrument suggest themselves.

—*Radio and Television News* (U.S.A.), August, 1951, p. 57.

Vector relationships of alternating voltages over a wide frequency range from 8 cycles to 500 megacycles can be measured by the instrument described. The output meter may be calibrated to indicate directly the phase angle in degrees between any two voltages.

—*Electronics* (U.S.A.), July, 1951, p. 124.

The use of Fourier's method of analysis of complex waves is well known. A description is given of a device which can produce a variety of complex waves which are used to check the computations in order to observe response. It operates by a light cell and produces the required harmonics.

—*Electronic Engineering* (U.S.A.), July, 1951, p. 584.

An audio frequency valve voltmeter is described, the requirements of which are somewhat different from the R.F. voltmeter.

—*Wireless World* (Eng.), June, 1951, p. 215.

MATERIALS, VALVES, AND SUBSIDIARY TECHNIQUES

High power magnetrons are used at the ultra-high frequencies for fast dielectric heating. One such tube generating 5 kw at 915 mc/sec. with associated control circuits is described.

—*Electronic Engineering* (U.S.A.), July, 1951, p. 626.

An ion trap in a picture tube is to avoid the development of dark areas appearing on the phospor by reason of ion bombardment in the centre of the screen. The trap deflects the ions and allows a free passage of the electrons.

—*Electronic Application Bulletin* (Holland), Vol. 11, No. 12, p. 237.

How to choose a valve. In this article is explained two figures of merit suitable for use by audio designers which assist them to choose valves from the great assortment available without guesswork.

—*Wireless World* (Eng.), June, 1951, p. 223.

Plastic materials, especially those based on polyvinyl chloride are replacing rubber and textiles as insulators. The composition of these materials is given, electrical properties, resistance to ageing, moisture, and chemicals.

—*Philips Technical Review*, Vol. 12, No. 4, p. 97.

The increasing use of X-rays, radium, and artificially produced isotopes has led to the need for many and varied types of instruments for electrical measurements. Ionization currents may be as low as 10-15A and suitable electronic amplifiers are required. The special types of valves needed are described.

—*Electrical Engineering* (Eng.) July, 1951, p. 258.

The experimental work referred to shows the suitability of transistors for frequency modulation. A wide variation of internal collector impedance is used to produce frequency modulation in an oscillator circuit, a conventional tube being used as the actual oscillator.

—*Electronics* (U.S.A.), July, 1951, p. 130.

MATHEMATICS

For students, vector diagrams tend to have an air of unreality. The writer has developed a visual aid to make the diagrams more vivid, the instrument being a CRT with a quiescent circular time base which produces the vectors by a derivation from pulses.

—*Electronic Engineering* (Eng.), July, 1951, p. 253.

RECEIVERS

Although the construction of FM receivers may be premature in New Zealand, some amateurs will be interested in a simple four-tube receiver. The circuit uses one half of a 12AT7 as combination mixer and super-regenerative detector at 21.75 mc/sec. and a CC4 as a local oscillator.

—*Radio and Television News* (U.S.A.), August, 1951, p. 50.

TRANSMITTERS AND TRANSMITTING

Amplitude modulation can be produced by phase modulation of two waves so that one will lead whilst the other is lagging and by the system described AM can be obtained without large modulators with the final tube in Class C. Details of the design given.

—*Ibid*, p. 54.

The new RCA walkie-talkies are miracles of miniaturization and two-way selective voice communication over about five miles is possible by the 16-tube equipment.

—*Radio and Hobbies* (Aust.), August, 1951, p. 17.

A 576 transceiver described. This is a continuation of last month's article in relation to the receiver portion, which uses a 959 as a self-quenched super-regenerative detector choke coupled to the second half of the 6SN7. Tuning is by lechers.

—*Ibid*, p. 60.

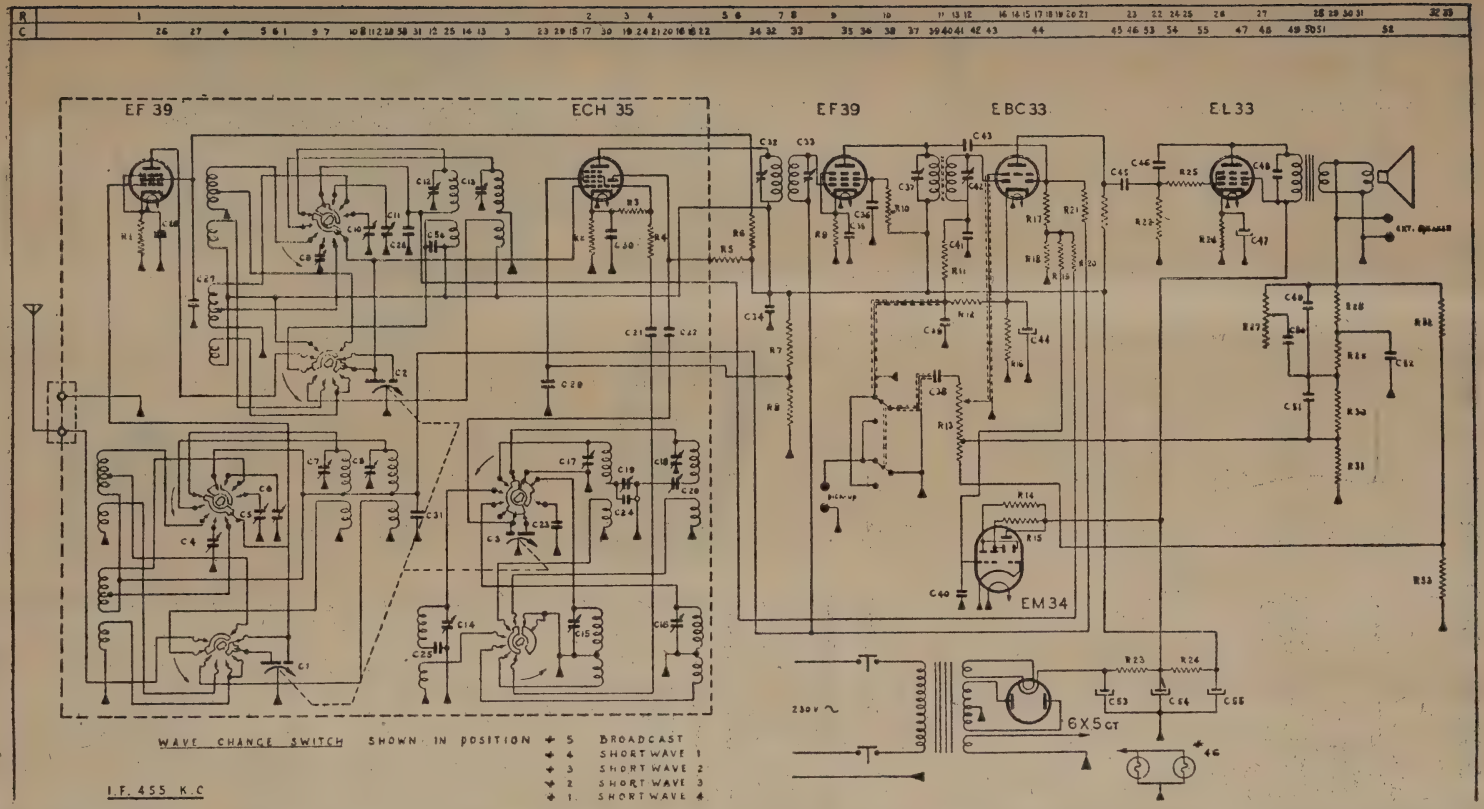
Higher and higher frequencies are being sought for more room on the ether. This article deals with the 900-960 mc/sec. region, frequency control, modulation, frequency multiplication, antennas, receiver noise considerations, and detection.

—*Electrical Engineering* (U.S.A.), July, 1951, p. 573.

(Concluded on Page 48.)

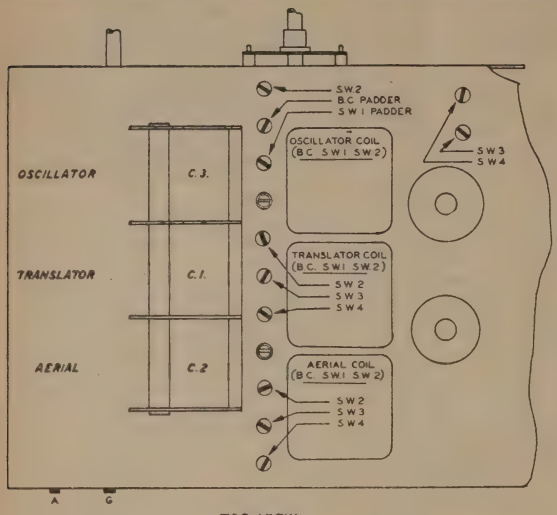
FOR THE SERVICEMAN

This month's circuit is that of the Philips Model 595. On page 32 is a trimmer diagram applicable to Philips Models 574, 595, and 601.

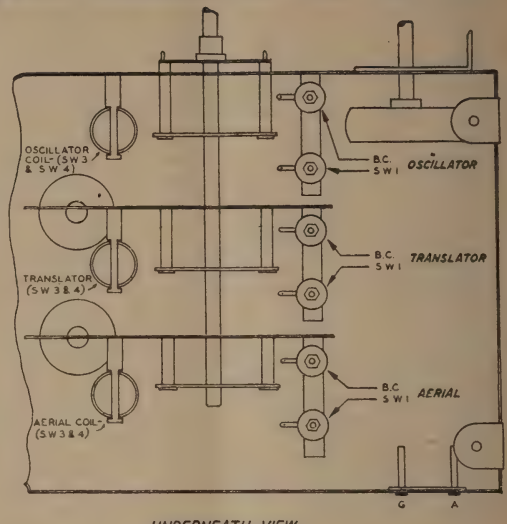


C1, C2, C3 — 3 gang split stator tuning cond.
C4 — 3-20 mmfd. — triple trim bank
C5 — 3-20 mmfd. — triple trim bank
C6 — 5-40 mmfd. — triple trim bank
C7 — 3-30 mmfd. air trim.
C8 — 3.30 mmfd. air trim.
C9 — 3-20 mmfd. — triple trim bank
C10 — 3-20 mmfd. — triple trim bank
C11 — 5-40 mmfd. — triple trim bank
C12 — 3-30 mmfd. air trim.
C13 — 3-30 mmfd. air trim.
C14 — 25-150 mmfd. trim.
C15 — 13-110 mmfd. trim.
C16 — 10-30 mmfd. trim.
C17 — 3-30 mmfd. air trim.
C18 — 3-30 mmfd. air trim.
C19 — 450-600 mmfd. padder
C20 — 450-600 mmfd. padder
C21 — 100 mmfd. mica
C22 — 100 mmfd. mica
C23 — 50 mmfd. negative temp. coeff.
C24 — .001 mfd. mica
C25 — .0065 mfd. mica
C26 — .05 mfd. 400v. paper
C27 — .05 mfd. 400v. paper
C28 — .05 mfd. 400v. paper
C29 — .05 mfd. 400v. paper
C30 — .05 mfd. 400v. paper
C31 — .05 mfd. 400v. paper
C32 — I.F. trimmer
C33 — I.F. trimmer
C34 — .25 mfd. 400v. paper
C35 — .05 mfd. 400v. paper
C36 — .01 mfd. 400v. paper
C37 — I.F. trimmer
C38 — .01 mfd. 400v. paper
C39 — 100 mmfd. mica
C40 — .05 mfd. 400v. paper
C41 — 100 mmfd. mica
C42 — I.F. trimmer
C43 — 10 mmfd. ceramic
C44 — 25 mfd. 25v. electro.
C45 — .01 mfd. 400v. paper
C46 — 100 mmfd. mica
C47 — 25 mfd. 25v. electro.
C48 — .0022 mfd. 400v. paper
C49 — 600 mmfd. mica
C50 — .02 mfd. 400v. paper
C51 — .02 mfd. 400v. paper
C52 — .01 mfd. 400 v. paper
C53 — 40 mfd. — triple electrolytic
C54 — 40 mfd. — triple electrolytic
C55 — 20 mfd. — triple electrolytic
C56 — 100 mmfd. mica
R1 — 200 ohms ½ watt
R2 — 200 ohms ½ watt
R3 — 50,000 ohms ½ watt
R4 — 200 ohms ½ watt
R5 — 25,000 ohms ½ watt
R6 — 100,000 ohms ½ watt
R7 — 25,000 ohms ½ watt
R8 — 50,000 ohms ½ watt
R9 — 330 ohms ½ watt
R10 — 100,000 ohms ½ watt
R11 — 47,000 ohms ½ watt
R12 — 1 meg ½ watt
R13 — 2 meg vol. control tapped .6 meg
R14 — 1 meg ½ watt
R15 — 1 meg ½ watt
R16 — 2,200 ohms ½ watt
R17 — 470,000 ohms ½ watt
R18 — 1 meg ½ watt
R19 — .5 meg ½ watt
R20 — 2 meg ½ watt
R21 — 2 meg. ½ watt
R22 — 470,000 ohms ½ watt
R23 — 900 ohms 6 watts
R24 — 2,200 ohms 3 watts
R25 — 47,000 ohms ½ watt
R26 — 150 ohms 1 watt
R27 — .5 meg tone control
R28 — 7,500 ohms ½ watt
R29 — 47,000 ohms ½ watt
R30 — 220,000 ohms ½ watt
R31 — 20,000 ohms ½ watt
R32 — 100 ohms ½ watt
R33 — 30 ohms ½ watt
R34 — 100,000 ohms ½ watt

TRIMMER POSITIONS PHILIPS RADIOPLAYER MODELS 547, 595, 597, 601



TOP VIEW



UNDERNEATH VIEW

TRIMMER POSITIONS — MODELS 547, 595, 597, 601.

Do you use the "R. and E." Photographic Service? For details see advertisements in previous issues.

TRAIN TRAVELLERS

Helpful Tips for Pleasant Trips

Add to the pleasure of your train journey by observing these golden rules:—

★ Avoid bother with baggage; address each bag clearly and, if possible, check it the day before you travel.

★ Assist quick service at refreshment rooms by tendering the correct money; note-changing at rush periods causes delay.

★ Before lighting your cigarette, make sure you are in a "smoking" car; other passengers will appreciate your thoughtfulness.

Another reminder: Many breakages of cups and saucers could be avoided by placing used crockery in a safe place on the station platform.

Unless it is quite unavoidable, please do not take refreshment-room crockery away in the train. Your co-operation will be appreciated by the Railways Refreshment Service.

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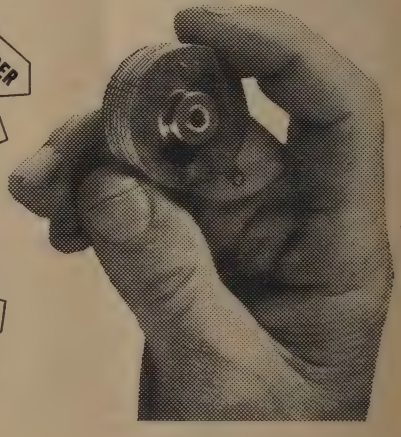
IT'S CHEAPER
LASTS LONGER
RUNS COOLER
SAVES SPACE



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Philips Experimenter

(Continued from Page 25.)

lator acts independently in suppressing the carrier that is fed to it, no carrier either appears in the output, which is therefore a pure single sideband.

This method has the advantage that no filter circuits at all are used, and that the carrier can be any radio frequency we please. The S.S.S.C. signal is thus generated, once for all, in a single operation, involving, if in turn can drive a medium or high-powered Class B stage, to give, at much smaller power supply requirement, an output equivalent to that of a 100-watt A.M. transmitter. In spite of the relatively large number of low-powered valves, the whole arrangement must easily be the least expensive transmitter in its power class that has been described in the amateur literature, since only the final Class B stage requires more than 250 volts or 50 ma. for its power supply.

The next Experimenter will go on to describe the actual equipment that has been built on the above plan.

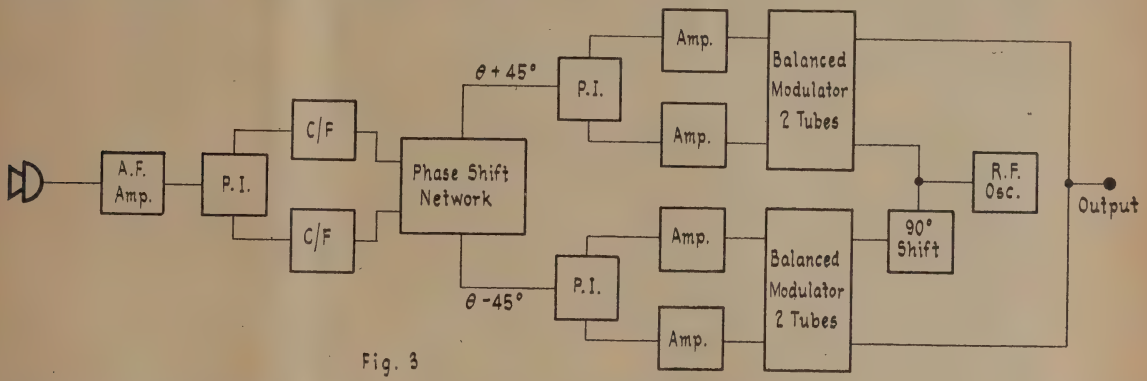

Fig. 3

desired, the actual frequency on which transmission is to take place.

Because the phasing method is somewhat easier to apply than the brute force method, and because suitable components for it will be easier to obtain, we have decided to base our first piece of S.SS.C. equipment on this method. The block diagram, Fig. 3, is an extended version of Fig. 2, and shows just what is involved in the way of valves and circuitry. First of all comes a conventional speech amplifier bringing the microphone output up to a level of about 15v. R.M.S. Then comes a simple resistance-coupled phase inverter, which is followed by a cathode follower at each of its outputs. The phase inverter is necessary because the particular type of phase shift network to be used required a push-pull input, and needs also to be fed from two low-impedance sources. The phase inverter and last stage of the speech amplifier use the two halves of a Philips ECC35, and for the majority of microphones, only a single additional stage of amplification will be needed ahead of this. The two cathode followers use the sections of a Philips ECC34, so that ahead of the phase shift network, only three valves are needed. The balanced modulators each use a pair of Philips EF50s. In each modulator, the grids are paralleled, and fed with R.F., while the screen grids are direct-coupled to the plates of a push-pull resistance-coupled amplifier. To provide the driving voltages for the two push-pull amplifiers, two more phase inverters are needed, one excited from each output of the phase shift network. The number of valves needed is not so large as might be imagined, because each push-pull amplifier uses a Philips ECC34, while the two phase inverters are also halves of a single ECC34. All told, ten valves are used, not counting the source of R.F., but as against this, no audio transformers, or A.F. centre-tapped chokes are needed, as in other similar systems that have been described, and the total drain from the H.T. supply is considerably less than 50 ma. The single-sideband output is only at low power, but provides about 90 volts of signal, which is more than enough to drive any low-powered Class A amplifier. This

Philips Experimenter Prototypes

In the past we have had numerous requests from readers of the Experimenter to purchase the prototype equipments that have been built as the basis of the articles. We have always regretted having to turn down these offers, so that it is with pleasure that we announce that we are now in a position to quote for exact duplicates of the originals. Inquiries should be addressed to Special Equipment Division, Philips Electrical Industries of New Zealand, Ltd., P.O. Box 2097, Wellington.

LOUDSPEAKER REPAIRS

We rebuild loudspeakers as new with genuine imported spare parts

INDOOR AERIALS "MAGIC"

45 ft. Coiled Aerials; attractively packed; 6s. 6d. retail

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RADIART CO.

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Special Transformers

Let us quote you for that Transformer which is NOT a stock size. We specialize in the odd varieties, including Audio Transformers and Smoothing Chokes.

PROMPT ATTENTION GIVEN

MR. C. O. STANLEY, C.B.E., Chairman of Pye, Limited, England, is the driving force behind the Pye Group of companies and an outstanding personality in the radio industry in the British Empire. Apart from his wide business interests, Mr. Stanley is a keen trout and salmon fisherman, an expert yachtsman, and a leading and successful breeder of Ayrshire cattle. Mr. Stanley visited New Zealand last year and is shown above (left) with MR. GEORGE WOOLLER, Managing Director of G. A. Wooller & Co., Ltd., and Chairman of Directors of Pye (New Zealand) Limited.

PYE (NEW ZEALAND) LTD.

"The formation of Pye (New Zealand) Limited marks an important forward step in the development of the radio and electronics industry in New Zealand," said Mr. G. A. Wooller, Chairman of Directors and Managing Director of the new company in an interview.

"I should like to quote to you some remarks passed by Mr. C. O. Stanley, C.B.E., Chairman of Pye Limited, England, at that company's annual meeting last July. He said: 'The countries which will be in a strong economic position in 1955–56 will be those countries which are food-producing and industry-building. The manufacturing and food-consuming countries will be correspondingly weak . . .'

"It is for this and for other good reasons that Pye (New Zealand) Limited has been formed as part of the vast international network of companies which comprise the Pye Group. Naturally enough, there has been a certain amount of talk around the local trade as to what is involved in these developments and I should like to take this opportunity of explaining to you just what is being done. As you know, G. A. Wooller & Co., Ltd., of which I am Managing Director, has since 1945 been the sole distributor of the output of Akrad Radio Corporation, Ltd., and has also distributed the products of other manufacturers, both local and overseas. I should like to make it clear that G. A. Wooller & Co. and the lines which it distributes will continue to function under my direction in exactly the same progressive manner as in the past, and dealers holding franchises for our lines will find that Wooller service is all that it has ever been.

"I should also like to make it clear that Akrad Radio Corporation, Ltd., will continue to develop and manufacture the well-known and highly successful Pacific, Regent, Flyer, and Five Star brands they have marketed since 1945. In addition to this, Akrad will shortly commence with the manufacture of Pye domestic radio receivers for the New Zealand market. The distribution of the Pye Group's products (with the exception of V.H.F. two-way radio) will be in the hands of Pye (New Zealand) Limited, which will shortly be engaged in setting up a network of retail outlets. It has been rumoured that this company intends to establish its own retail outlets, but I should like to state emphatically that this is not correct. Distribution of Pye products will be through established retail organizations.

"The products of Pye Telecommunications Ltd. have for some years been distributed by Messrs. Green & Cooper, Ltd., and the success of their distribution is evidenced in the widespread use of Pye V.H.F. communications equipment in this country. Green & Cooper, Ltd., will continue to act as agents for telecommunication equipment which they have so successfully put on the market in New Zealand." Eventually it is intended to manufacture telecommunication and specialized equipment at the Akrad factory. Mr. A. M. Cooper has been invited to join the Board of Directors of Pye (New Zealand) Limited, which will include Mr. T. J. F. Spencer (Managing Director of Akrad) and Mr. A. Fell of London, with Mr. G. A. Wooller as Chairman and Managing Director.

PYE LIMITED, ENGLAND

In Cambridge, England, in 1896, Mr. W. G. Pye, previously of the Cavendish laboratories, set up in business as a manufacturer of scientific instruments for schools and laboratories. By 1913 the business had expanded considerably and a staff of sixty worked in a factory with a floor space of 13,000 square feet. During the First World War the company produced large quantities of signalling equipment for the Armed Forces and after the war became interested in wireless telegraphy and telephony, producing in 1922 the world's first portable radio receiver—a battery model with a frame aerial.

The company of Pye Limited was formed in 1929 and continued to expand until in 1938 the company was employing 1600 people, with factory space of 138,000 square feet. Other companies were joining the Pye Group, which by this time was manufacturing radio receivers and domestic electrical appliances. At the same time intensive research into electronics in all its departments was equipping the group for the vast task ahead of it.

The Second World War saw Pye Limited mass producing radar and communications equipment; producing designs which were subsequently manufactured in Canada, Australia, and U.S.A.; developing radio actuated fuses, gunsights, and air navigational apparatus; manufacturing practically all the forward area communications equipment of the British Army.

Pye Telecommunications Limited, which was formed to handle this side of the business, is today one of the most flourishing companies in the Pye Group. Five hundred people are employed developing and manufacturing the equipment used in the majority of radio-controlled ambulances, police cars, tugs, etc. The first radio-controlled fleet of taxis in Europe was Pye-equipped and many others have since followed suit.

Pye's research in television and radar before the war enabled the company to make great headway when television transmission resumed in 1946 and in that year one-third of the receivers marketed in Britain bore the Pye trademark. Until Pye Limited produced the first transformerless design, television receivers always incorporated a large, heavy, and expensive transformer. Pye showed the transformerless technique was possible and the first table receiver at £56 3s. and the console at £70 3s. 9d. were approximately 25 per cent. lower in price than their competitors.

Pye Limited were the first manufacturers to incorporate a black or tinted viewing screen in their receivers, making daylight viewing much more enjoyable. Today three shifts are engaged producing 3000 TV sets per week, and even this production is not sufficient to cope with the demand. With its associated and subsidiary com-

(Centre) *MR. A. M. (Don) COOPER started his business career in the early days of radio, and was associated with amateur transmitters even prior to 1926, eventually joining Mr. W. S. Green in the business known as Green and Cooper, Limited. On the retirement from that company of W. S. Green, Don Cooper took over the Managing Directorship. He is the holder of a First-Class P.M.G. Certificate and is also an Associate Member of the British Institute of Radio Engineers. During the last World War he served in the R.N.Z.A.F. as an instructor in radar in the United Kingdom, later being responsible for certain radar installations in New Zealand and the Solomon Islands. Mr. Cooper has recently visited Great Britain, where he spent some time with Pye Limited in their several organizations and with other business houses for whom his company is New Zealand representative.*

(Right) *MR. PETER THRELFALL, Executive-Director and Export Manager of Pye, Limited, England, who has played a very vital part, together with Pye Limited Liaison Office, in the negotiations leading up to the formation of Pye (New Zealand) Limited.*

(Left) *MR. A. FELL was born in England, educated in New Zealand (at Hamilton and Tauranga), and returned to England in 1933. In 1945 he entered politics and has since fought two by-elections and a General Election for the Conservatives. He is again standing as Conservative candidate for Great Yarmouth in this month's General Election. Mr. Fell has been invited to join the Board of Pye (New Zealand) Limited.*

panies, Pye Limited is one of the largest manufacturers of television (both transmitting and receiving) apparatus in Britain today. More Pye receivers are in use than any other make, while on the transmitting side the cameras and studio equipment made by this company are doing much to uphold the name of Britain in the world-wide field of television.

The production of domestic radio receivers has kept pace with, and even exceeded, that of television. Pye Limited is the largest exporter of radio in the British Empire and at its main factory alone produces for export in excess of 4000 domestic radios per week.

The fields in which the companies of the Pye Group are engaged are wide and numerous; products range from the amazingly intricate precision instruments made by Unicam for all branches of science to the more mundane but always essential household electrical appliances produced by L. G. Hawkins, Ltd. Manufacturing units are located at Cambridge, England; Larne, Northern Ireland; in Eire, Canada, South Africa, and Australia. There are established markets in all the Americas, the whole territories of Africa, Middle East, and Far East, Europe, Australia, and now New Zealand. Other activities of companies in the group embrace the following: Telecommunication equipment, including H.F. and V.H.F. designs; I.L.S. blind landing equipment for civil and military use; a wide variety of military equipment; scientific instruments; electronic equipment and components. Today world turnover exceeds £8,000,000 sterling and new markets, new activities, and new branches of electronics are being constantly developed. Just how successfully this is being done is shown by trading figures for the year ended 31st March, 1951, in which period the Pye Group of companies earned profits aggregating £536,930.

AKRAD RADIO CORPORATION

In Waihi, New Zealand, in 1934, the late Mr. K. M. Wrigley commenced a radio servicing business which rapidly expanded, as Akrad Radio Corporation, into the sphere of domestic radio manufacture and by the outbreak of the Second World War was employing a staff of 40. During the war the factory played its part with other members of the New Zealand industry in the manufacture of electronic equipment for the Armed Forces and at the end of hostilities a total staff of 90 was employed. With the return of peace, the manufacture of domestic radio was resumed and under the direction of experienced and highly skilled technicians a capable and versatile manufacturing unit was built up. At the same time, the company set out to manufacture a range of tricycles which has become a credit to New Zealand industry. Practically every item used in the manufacture of the tricycles, with the exception of raw materials, is manufactured on the company's premises. Since 1946, 53,000 tricycles at ex-factory value of £250,000 have been produced at Waihi, and this year's production target is set at 12,500 tricycles.

With the appointment in 1945 of Messrs. G. A. Wooller & Co., Ltd., as sole distributors of Akrad's output, the company's brands—Pacific, Regent, Five Star, Flyer—embarked on a programme of expansion in fields which are renowned for their keenness of competition. Their factory has extended over three sites, totalling 17,000 square feet, employing a staff of 150. Land has been purchased for factory developments, which include plans for manufacturing several items in addition to Pye domestic radio receivers and the range of products at present being produced in Waihi.

G. A. WOOLLER & CO. LTD.

In Auckland in 1945, Mr. G. A. Wooller founded the company of G. A. Wooller & Co., Ltd., distributors of Radio, Electrical, and other products. Mr. Wooller has been in radio since 1932 when he started on the wiring line at Radio Ltd., eventually working his way through the plant to the position of Production Manager, and for a short period, Factory Manager. In 1941 he was seconded to the Ministry of Supply and Munitons as Senior Project Officer under Controller of Radio Production. For the next four years he was virtually production manager for the whole of the radio industry, gearing its production to wartime requirements and placing some millions of pounds' worth of contracts with the radio and other industries. In the years since,

Mr. T. J. F. SPENCER

Mr. Spencer is a qualified accountant who has always been intensely interested in radio and its many ramifications. A radio experimenter since 1921, Mr. Spencer is the holder of a first-class certificate in Radio Technology. For the last five years he has been manager of Akrad Radio Corporation Ltd., and was recently appointed Managing Director. Mr. Spencer, who has been invited to join the Board of Pye New Zealand, Ltd., is well known to the industry as President of the New Zealand Radio and Television Manufacturers' Federation.

Mr. Wooller has frequently paid tribute to the excellence of the training he received in Government departments.

When the war finished, Mr. Wooller, seeing the possibilities of Akrad Radio Corporation as a manufacturing unit, formed his own company to sell and distribute Akrad's entire output. The growth of G. A. Wooller & Co., Ltd. in the last six years has been a measure of the development of Akrad Radio Corporation, Ltd., but at the same time several important supporting lines have been added to the Wooller range. Notable among these are the sole New Zealand distribution of Crosley Shelvador Refrigerators; North Island distribution of Scott Washing Machines; wholesale distribution of Sunbeam Mixmaster and other Sunbeam products to follow; sole New Zealand distribution of Autocrat, New Zealand's largest selling car radio.

NEW PRODUCTS: LATEST RELEASES IN ELECTRICAL AND ELECTRONIC EQUIPMENT

This section of our paper is reserved for the introduction of new products and space preference is given to our regular advertisers. Advertising rates are charged according to space occupied. For further particulars contact Advertising Manager, R. and E., Box 8022, Wellington.

"CHANCERY" L.P. RECORD ATTACHMENT

The Swan Electric Co., Ltd., announce their appointment as exclusive New Zealand distributors of Chancery Precision Instrument Service, Ltd., England, manufacturers of the unique Chancery Long-playing attachment which enables the playing of L.P. records on existing radiograms or record players. Together with the attachment there will be available the Chancery high fidelity microcell pick-up for standard and long-playing records.

The device is precison engineered of advanced design, its compactness and its simplicity of operation and fixing enabling users of normal radiogramophone and record playing equipment to enjoy the outstanding reproduction and other known advantages of long playing records.

The attachments will soon be available and inquiries are invited to your nearest branch of the Swan Electric Co., Ltd.

"ULTIMATE" (Radio (1936) Limited)
6-Valve Dual Wave A.C. Console
7-Valve Bandspread A.C. Console

A beautifully proportioned cabinet that appeals to the eye, that adds richness to the tonal reproduction of both the 6-valve and 7-valve receiver! A magnificent cabinet designed to complement modern homes and furnishings whilst giving a clarity and richness of performance that is a delight to the ear.

Though only the 7-valve console is fitted with a magic eye, both consoles have Petonic Tone Control, full vision tuning and staggered station calibration. Both receivers are fitted for separate gramophone input and remote speaker phone jacks.

A 12-inch pretested Rola P.M. speaker, a new range of valves, including high slope output KT61s ensures maximum sensitivity, selectivity, and natural response.

SPECIFICATIONS

6-Valve Dual-wave

Valves: 1 7B7, 1 7S7, 1 6AR7GT, 1 6SQ7GT, 1 KT61, 1 7Y4.

Voltage: 230 volts, 50 cycles.
Mains consumption: 60 watts.
Coverage: BC., 550-1600 kc/sec; SW., 16–49 metres.
Speaker: 12 in. Rola.
Cabinet: Walnut veneer.

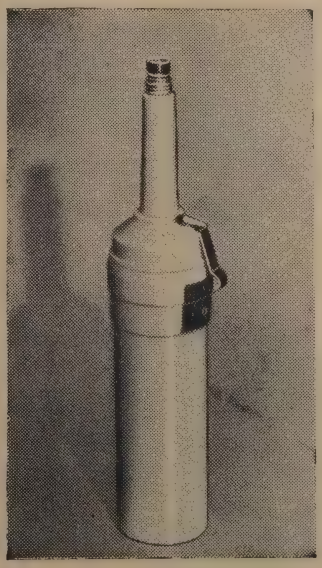
Dimensions: 36¼ in. high, 26¼ in. wide, 14 in. deep.

7-Valve Bandspread

Valves: 1 7B7, 1 7S7, 1 6AR7GT, 1 6SQ7GT, 1 KT61, 1 7Y4., 1 6U5G.

Voltage: 230 volts, 50 cycles.
Mains consumption: 60 watts.
Coverage: BC., 550–1600 kc/sec., SW., 13–80 metres.
Speaker: 12 in. Rola.
Cabinet: Walnut veneer.
Dimensions: 36¼ in. high, 26¼ in. wide, 14 in. deep.

"GROVER" GAS LIGHTER



Illustrated is a completely new type of Gas Lighter which has recently appeared on the market. The "Grover" Gas Lighter is of plastic and is available in numerous colours. Two standard No. 950 torch cells are used and tests have proved that over 12 months' use can be obtained from one set of batteries. By removing the tip and inserting a 2.5 volt torch bulb the lighter becomes a handy emergency torch. Each Gas Lighter is individually cartoned and attractive showcards are available.

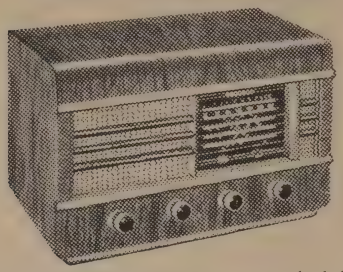
Supplies can be obtained from any Branch of the Grover Electrical Co., Ltd.

(Continued on Page 38.)

New Products

(Continued from Page 37.)

H.M.V. "DOVER"
6-Valve Dual-wave Model



Complete radio recreation is the underlying theme of the new His Master's Voice "Dover" radio, recently released by H.M.V. (N.Z.), Ltd. A powerful set with compensated tonal range, the "Dover" gives an equally good performance on sea coast or inland. The cabinet is attractively finished in figured walnut. Short specification is:—

Cabinet: 20½ in. wide, 12⅓ in. high, 9½ in. deep.
Valve Complement: (1) 7B7, R.F. amplifier; (2) 7S7, mixer-oscillator; (3) 7B7, I.F. amplifier; (4) 7C6, demodulator; (5) 7C5, audio output; (6) 7Y4, rectifier.
Frequency range: 535–1640 kc/sec., 6–20 mc/sec.
I.F. Frequency: 455 kc/sec.
Power supply: 230 volts, 50 cycles.

BOOKS FOR AMATEUR STUDENT SERVICEMAN ENGINEER

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A.R.R.L. ANTENNA BOOK 15/-

RADIO ENGINEERS' HANDBOOK, Terman New Edition 63/-

RCA TUBE MANUALS 4/6

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Proceedings of the New Zealand Electronics Institute (Inc.)

HEADQUARTERS NEWS

A Council meeting was held recently and considerable business was transacted.

Brochure

Members who are interested in informing their friends of the activities of the Institute would be well advised to obtain copies of the Institute brochure which gives full details regarding membership of the Institute. Already copies of this brochure have been distributed throughout the Dominion and a quickening of interest in the Institute has resulted therefrom.

Awards

A sub-committee has been appointed to go into the question of prize awards for the best paper submitted for publication and members will be informed regarding this matter at a later date.

Outstanding Subscriptions

There are still several members who have not yet paid their current subscriptions and it is with reluctance that the Executive Council find it necessary to stop delivery of *Radio and Electronics* to these members. If you should be unfinancial, therefore, would you please remit your subscription promptly in order to retain continuity of delivery of this publication.

Admissions Committee

The following members were admitted to the Institute in the status as detailed and the Executive Council would extend a warm welcome to these individuals, all of whom would be well advised to keep touch with their local branch activity and thus obtain the full benefits of membership.

AM66 Sidney Philp Wills, 1 Gamblins Road, St. Martins, Christchurch, S.E.2., Associate Member.

AM67 Basil Ernest Graham Goodger, 76D Rongotai Tce., Wellington, E.9, Associate Member.

A150 Edward Thomas Firth, 43 Roy St., Wellington, S.1, Associate.

A151 Benson Stafford Furby, c/o 2ZB, Box 6166, Te Aro, Wellington, Associate.

A152 Alexander Kerr MacDonald, c/o Transmitting Station, Henderson, Auckland, Associate.

A153 Keith Francis Robbins, 83 Springfield Rd., St. Albans, Christchurch, N.1, Associate.

S187 Norman Cedric Batty, 51 Palmerston St., Greymouth, Student.

S188 Murray George Cowan, S.R.S., R.N.Z.A.F. Station, Ohakea, Student.

S189 Trevor Richard Ferguson, c/o 4YZ, Box 98, Invercargill, Student.

S190 John Robert Gabriel, 36 Park St., Dunedin, N.1, Student.

S191 Russell Leonard Lambert, 123 Bright St., Cobden, Greymouth, Student.

S192 Robin Noel Robins, Public Service Hostel, Oriental Bay, Wellington, Student.

Transfer from grade of Associate to that of Associate Member approved: AM68 Frederick Joseph Jacobs, c/o 3ZB, Box 24, Greymouth, Associate Member.

Re the Late Lord Rutherford

It was agreed by Council that a letter received from the Business Manager of the New Zealand Association of Scientific Workers in connection with an endowment covering the Rutherford Memorial Foundation should be published in the proceedings so that all members would be aware of the steps being taken to commemorate the memory of the late Lord Rutherford. This letter is therefore reproduced below:—

THE LATE LORD RUTHERFORD

"In connection with the appeal which is soon to be launched in New Zealand and overseas for funds to endow a Rutherford Memorial Foundation, the *New Zealand Science Review* is bringing out a special Rutherford Memorial number, to be published next month.

"The main articles of this issue will be:—

"'Rutherford at Canterbury College,' by Professor R. S. Allan.

"'Rutherford at McGill and Manchester,' by Professor D. C. H. Florance.

"'Rutherford at Cambridge,' by Dr. G. T. P. Tarrant.

"'Rutherford the Man," by Dr. E. Marsden.

"'The Significance of Rutherford's Work,' by Professor R. R. Nimmo.

"'Rutherford's Early Life,' by Dr. L. Bastings.

"Five of the authors are past students of the great scientist, and the issue will also include some unpublished photographs of him. A good deal of interest has been shown in some quarters in the Memorial project, and it has been suggested that the members of your Society might be glad to hear of this additional information.

"The purpose of this circular is to bring the matter to your attention, and to ask your co-operation in bringing it to the attention of your members. These special issues are apt to sell out very quickly, and it is almost impossible to estimate requirements with any certainty. If, therefore, you have a suitable opportunity at a meeting, or in your journal, if you publish one, to suggest to your members that anyone wishing to receive a copy should order before the publication date, it would be greatly appreciated.

"The price is 2s. per copy posted; the order should be sent to the Busniess Manager, P.O. Box 3001, Wellington, with cash enclosed, by 6th August, 1951."

(Note.—Since the above letter was received, a meeting has been held in Wellington and representatives appointed to consider various aspects of the work involved in implementing the project detailed in the above letter.)

CHRISTCHURCH BRANCH

The last meeting of the Christchurch Branch was held in the Electrical Lecture Room, Canterbury University College, on Monday, 1st October, at 7.30 p.m. Mr. B. T. Withers discussed matters pertaining to the commissioning of the experimental television system at Canterbury College and following on this discussion the meeting adjourned to the electronics laboratory where the equipment was demonstrated.

DUNEDIN BRANCH

The last meeting of the Dunedin Branch of the Institute was held on 16th August, 1951, when, after the disposal of routine business, Mr. Halchrow, District Engineer for the Broadcasting Service, escorted members on an inspection of the control panels of the various stations. A full explanation of the operations was given by Mr. Frank Barnett and he gave those present a good idea of the complex radio engineering necessary for the operation of modern broadcasting.

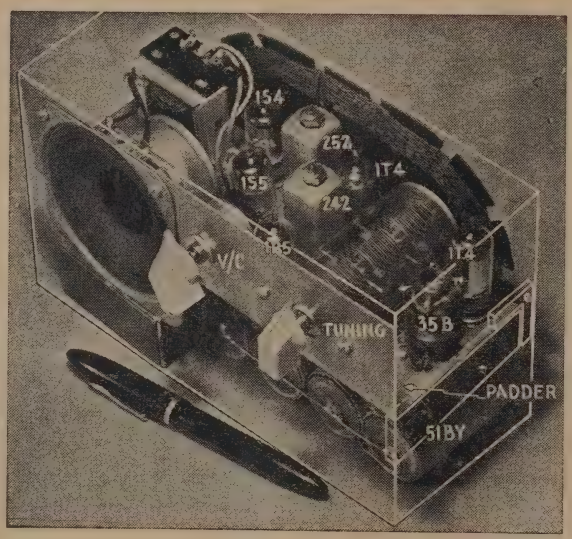
The magnetic tape recorders and players were also demonstrated in detail and the simplicity of operation of such intricate machines was a point of interest. The record cutting machines were also explained and interest was shown in their quality and design.

The evening was a most enjoyable experience and members present were greatly indebted to Mr. Halchrow for his courtesy and also for his kindnes in being present personally to explain the equipment.

WELLINGTON BRANCH

The latest Wellington Branch meeting was held on Thursday, 11th October, when a very full attendance of members and visitors heard a very interesting address by Mr. J. Simpson on the interpretation of oscilloscope patterns. Mr. Simpson's lecture was illustrated by demonstrations of the main points on a twelve-inch oscilloscope. With the aid of an apparatus for synthesizing wave-forms, very interesting demonstrations were given showing the exact effects of different types of distortion, and how square, triangular, and other wave shapes could be built up.

Do you use the "R. and E." Photographic Service? For details see advertisements in previous issues.



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TRADE WINDS

Auckland Provincial Radio Traders' Association

The Auckland Provincial Radio Traders' Association announces that discussions have taken place between a sub-committee of the Executive and the Seddon Memorial Technical College, Auckland, and arrangements made for the running of a course of TV techniques, provided sufficient names can be registered to make the classes worthwhile. A circular has been sent out to members of this association urging enrolment of servicemen employed by members. Classes would be commenced at the beginning of the coming school year and would last for two years. An outline of the syllabus has been circulated, details of which will be dealt with in following issues of *Radio and Electronics.*

* * *

World Radio Figure Dies in Holland

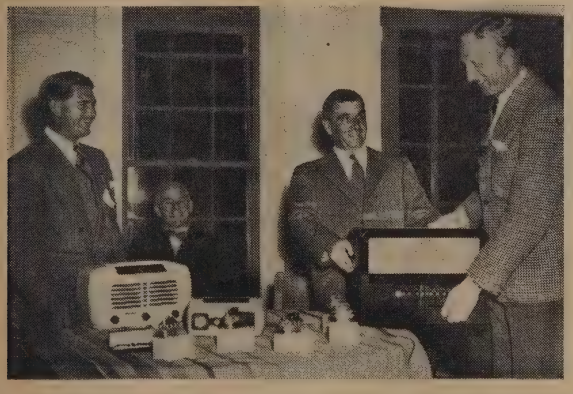
Dr. Anton Frederick Philips, a leading figure in the field of radio and its allied equipment, died in Holland on 21st September, at the age of 77.

For 55 years he devoted all his energy and enthusiasm to the building up of a business that has factories in 26 countries and employs 80,000 people.

* * *

"Pacific" and "Regent" Golf Tournament

Mr. G. A. Wooller who has been overseas on a business trip to England and the U.S.A., arrived back in time to officiate at the prize distribution to winners of the "Pacific" and "Regent" radio £500 golf tournament. Peter Thomson, of Melbourne, won the first prize in the professional section and received a cheque for £200. Thomson's total for the four rounds was 285, and his



65 in the last round was an outstanding achievement being four below the previous record of 69 for the Middlemore course.

D. L. Woon, leader in the amateur section is shown here receiving his trophy from Mr. E. C. Brown, President of the Auckland Golf Club, while at the left is Mr. G. A. Wooller representing the sponsors (G. A. Wooller and Co., Auckland). Seated is Mr. J. N. Luxford, S.M., President of Heritage (Auckland) Inc., to whom the proceeds of the tournament were donated.

* * *

Mr. L. G. Hawkins, a Director of Pye Limited, England, accompanied by his wife and daughter, is visiting New Zealand this month. Mr. Hawkins is Chairman of L. G. Hawkins and Co., Ltd., manufacturers of Hawkins electrical appliances ,including electric irons, pressure cookers, and a whole range of electrical goods.

* * *

New Public Company Formed for Radio Manufacture

A new public company, New Zealand Consolidated Industries, Ltd., has been floated in Auckland with an authorized capital of £10,000, of which £1140 has been initially subscribed. The company will manufacture and deal in telephone, telegraph, radiophone, and wireless equipment, etc.—*N.Z. Herald.*

* * *

A New Radio Magazine

The editors of "Radio and Electronics" have for some time felt that there is a need for a small, inexpensive magazine, devoted solely to audio and radio hobbyists, presenting numerous circuits, articles for the beginning amateur transmitter, the DX-er, and the beginner in radio. It has been decided, accordingly, to bring out such a publication in the near future, under the title of "Radio-Gen.' It is hoped that "Radio-Gen" will make its first public appearance early in December. The retail price will be 9d., and in order to keep the price down to this figure we have decided to undertake the distribution ourselves.

The new magazine should be an excellent medium for boosting the sale of radio parts to the hobbyist and amateur experimenter, and as such we are inviting radio parts retailers to undertake the retail sale of "Radio-Gen." Those interested are cordially invited to submit orders immediately. In order to conserve paper, the new magazine will be sold on firm order only, and orders for fewer than six copies are not able to be accepted. Inquiries should be addressed to: The Managing Editor, "Radio-Gen," P.O. Box 8022, Wellington.

A limited amount only of advertising space is available for the first issue, and parts dealers are invited to inquire for rates, etc., to the above address.

* * *

Radio for Wellington's New Pilot Launch

To be delivered in about 12 months' time, and costing £41,000, Wellington Harbour Board's new pilot launch is to have elaborate radio equipment for which the successful tenderers were Messrs. Collier and Beale, Ltd., of Wellington, as representatives of British Redifon. The GR60A equipment to be installed is specially designed for rigorous shipboard conditions. The transmitter provides instant switching among eight crystal-controlled frequencies, and the receiver is tunable between 350 kc/sec. and 8 mc/sec. A loud-hailer apparatus is included. Power is derived from a 24-volt D.C. source, driving a motor generator.

PUBLICATIONS RECEIVED

Radiotronics, August, September, 1951. Amalgamated Wireless Valve Co., Pty., Ltd.

Electrical Communications, March 1951. International Telephone and Telegraph Corporation. (S.T.C., Ltd.)

Philips Bulletin, July-September, 1951. Philips Electrical Industries of N.Z. Ltd.

Pamphlet: The Collaro Series of Single and Three Speed Automatic Record Changers (Russell Import Co., Ltd.).

Philips Technical Review, October, 1950: Philips Gloielampen-Fobrieken, Eindoven (Philips Electrical Industries of N.Z., Ltd.)

The Strowger Journal, April, 1951. Automatic Telephone and Electric Co., Ltd., England (Automatic Telephone Co., N.Z., Ltd.)

Catalogue: Widney Dorlec Cabinet System and Telescopic Mountings, Hallam Sleigh and Chaston, Ltd., England. (W. G. Leatham, Ltd.)

Descriptive Card Walchris "Supersound" Gramophone Pick-up. (W. S. Green, Ltd.)

Sylvania News, June-July, 1951. Sylvania Electric Products, Inc. (G. A. Wooller and Co., Ltd.)

Bulletin Nos. 102 and 103. Fixed Mica Dielectric, Aramicon and Mica Capacitors. Also Data Sheets for Paper Tubular "Cap Seal" Type PE, Silvered Ceramic Tubular Types N.750, N.P.O., and HI-K., Semi-dry Electrolytics Types ET, EE, EG, EEO, and EEc., Ducon N.Z. Ltd.

Enterprise, September, 1951. Cory-Wright and Salmon, Ltd.

CLASSIFIED ADVERTISEMENTS

Rates are 3d. a word, with a minimum charge of 2s. Advertisements must be to hand in this office not later than the tenth day of the month in order to be published in the issue appearing at the beginning of the following month.

While all care will be taken, no responsibility can be accepted for errors. Advertisements should therefore be submitted either typed or printed in block letters.

FOR SALE.—Byer R-12-D Disk Recorder. New condition. Pick-up, Amplifier, and Microphone if required. Duston, c/o Box 6012, Wellington.

COMPLETE English Disk Recorder, good condition and response to 7k. Recording blanks and cutters included, £30. Would exchange for 12/230v. 150-watt inverter in like condition. Radio Traders, Box 194, Dannevirke.

WANTED TO BUY—Receiver Type R-1084, complete. Please reply to D. C. Sutherland (ZL2AJL), Warrengate Road, Wanganui.

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The "R. & E." Amateur Television Project

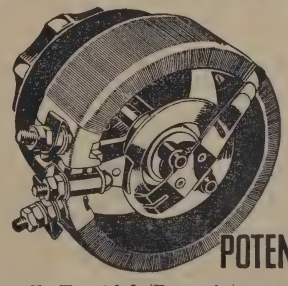
Part VII—Setting Up the Completed System

We have now described all the component parts of the TV system, and all that remains is to hitch them together in the correct way, make what adjustments may be necessary, and observe the results! Put that way, it all sounds very simple, and so it is, as long as each separate circuit is made to work individually. The first essential is to get the transmitting tube and its deflection circuits working properly, and most builders will probably have done this long since. With the VCR112 cathode ray tube, the deflection circuits originally described will give only about two to three inches of deflection in the line direction, because the output voltage of the 6AC7 deflection amplifiers is not great enough to give more than this deflection. However, there is no need to worry about this, because our own first pictures were obtained with a raster no wider than this. In proper television systems, it is standard to make the picture area rectangular, after the fashion of a cinema picture, with a ratio of length to height of either 4 : 3 or 5 : 4. For our experimental purposes, however, there is no need at all to do this, so that the best plan is to make the raster square. This can be done by using the full undistorted output of the line amplifier, and adjusting the amplitude of the frame deflection. The latter circuit gives a much greater undistorted output than the line amplifier, and there will be no difficulty in obtaining a square raster. When this has been done, the receiving C.R.T. can be set up. All we need for this tube is the bare power supply, with its brilliance and focus controls. Indeed, for anyone who has an ordinary oscilloscope, there will be no necessity to make up a special receiving C.R.T. at all, as the 'scope itself can be used. If this is only of the three-inch variety, with the kind of C.R.T. which has one of each pair of deflecting plates connected together, it will still be necessary to build the special receiving tube circuit, preferably using a VCR97 or a 5BP1, but preferably the former, since this type usually gives a much better spot of finer focus, and consequently makes a better picture. However, when setting up the apparatus, it is much better not to try and get a picture immediately. By exercising a little patience, and setting up the video circuits using the receiving C.R.T. simply as a 'scope, it is possible to adjust the circuits so that when the final hook-up is made, the picture will be an excellent one at first turning on.

After setting up the transmitting tube, therefore, the next thing is to set up the photocell and the video amplifiers. The photocell is placed about four inches from the raster on the transmitting tube, and the following connections are made. Leads are taken from the line time-base to the X plates of the 'scope or the receiving tube through a blocking condenser. Note that if a 'scope is being used, the built-in amplifiers should NOT be used, because we want to investigate the behaviour of the amplifier circuits we have constructed, and if we use the built-in amplifier of the 'scope, the results will be modified by this amplifier, and will not represent the performance of the video amplifier alone.

The next step is to take a strip of some opaque material, about half an inch wide. The material does not matter. It can be cardboard, tin or brass, or anything else, as long as it will not let light through. Care should be taken to see that its long sides are as accurately parallel as possible. Then one end of it is attached to the face of the transmitting C.R.T. with sticking plaster or cellotape, at the *top* of the raster. In this way, the strip, when fixed down at the other end, runs across the lines. If the lines are horizontal, as is conventional in TV practice, the strip will thus run vertically. Let it hang down, without fixing the lower end, and we are now ready to make the first adjustments. First of all, the raster on the transmitting tube is turned to somewhere near full brilliance, and focused as well as possible by eye, just as a 'scope is focused. Then, on looking at the 'scope, we should see a horizontal line, with an almost rectangular deflection on it. This deflection represents the video signal generated by the system. Ideally, it should be a sharply defined square wave, because with a single bar across the lines of the raster, each line should produce a square wave starting at the same time after the start of the line, and also finishing at the same time after the start. It is more likely, however, that the rising and falling edges of the square wave are quite fuzzy. This will be due to the fact that in all probability the bar is not lying at right-angles to the lines of the raster. As a result, the square wave produced by each line starts at a slightly different time from that of the next, so that on the 'scope these leading edges overlap, and produce a fuzzy line. To prove this, the free end of the bar can be moved slightly until the edges of the square wave on the 'scope are as narrow and sharply defined as possible. At this point, the lower end of the bar is fixed in position with tape, and left

CRESSALL



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set. We can now examine the output square wave more closely.

If the equipment were ideal (which it can never be) the square wave of output from the video amplifier would be quite rectangular, with vertical sides, and sharp corners, but the aim of our adjustment is to make the output square wave as much like the ideal as possible. This has been taken care of in the design of the special videa amplifier whose circuit was given in the last instalment of this series, so that all the constructor has to do is to adjust the 60 $\mu\mu$f. top-boost condenser in the grid circuit of the first 6AC7 amplifier tube. If the output wave is examined while the variable condenser is adjusted, it will be seen that the edges of the output pulse become progressively sharper as the capacity is increased, and it might be thought that the best adjustment was the one which gave the sharpest possible leading and trailing edges to the square wave. However, this is not so, because as the capacity is increased, another phenomenon becomes visible. The left-hand, or leading edge is not affected, but at the trailing edge, it is found that instead of the square wave returning rapidly to the base-line, it starts to go beyond it, producing quite a pronounced peak in the *opposite* direction to the main part of the square wave. Now this happens *after* the wave should have been completed (*i.e.*, after the trailing edge has supposedly returned to the base line, and, since it is an unwanted change in the output amplitude, it will have an undesirable effect on the picture. This *overshoot*, as it is called, produces on the actual picture an effect that is usually called "black after white," and from an examination of the square wave of output it is easy to see where the name comes from. For example, suppose that the phase inversion switch is in the position that makes a positive output from the last tube represent white in the picture, then an overshoot amounts to a negative output pulse, and this must, therefore, drive the C.R.T. grid in the direction that gives *black* on the received picture. Now in terms of a picture, the wave form we are observing represents a vertical black bar, and so, if we are showing the output pulse in the right polarity, the pulse will be negative, or downwards from the base line, which represents the *white* signal level in this case, because practically the whole of the picture area is white. The bottom of the square pulse represents the black level. Now the overshoot will go up higher than the base line, and will increase the brilliance of the trace immediately to the right of the edge of the black band on the picture.. But since the spot is at full brilliance except for the black band, the overshoot will have little or no visible effect. But if the picture were reversed, by leaving a white band in the same position as the black one, the polarity of the output pulse would then be positive, and the overshoot would be negative, driving the C.R.T. towards black. Now where the picture is completely black and white, the effect on the picture is not visible, but where we have a half-tone picture, with varying degrees of shading, a very noticeable effect occurs. After every sharp white vertical edge, there appears a narrow,

"SKIPPER"

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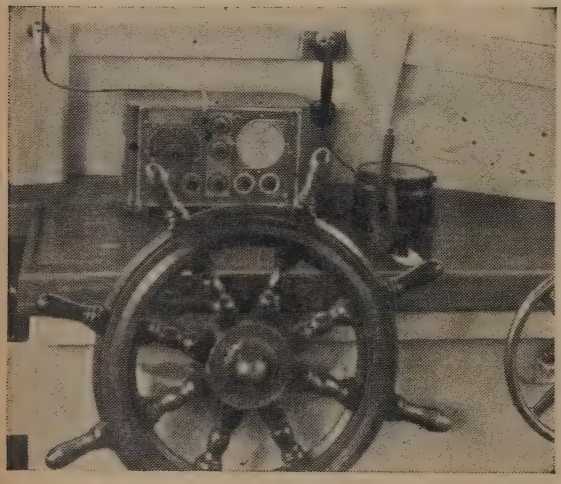

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quite black line, irrespective of whether the white edge is followed by dead black in the actual picture, or not. The effect is to increase the sharpness of well-defined outlines in the picture, and to make everything look as if it were standing out in relief. For this reason it is sometimes called *plastic distortion*. TV engineers admit that a small degree of black-after white is a good thing, as it gives an effect of sharpness which is rather the same as increasing the definition of the picture slightly, but if overdone, it makes the picture look very unreal, and is definitely undesirable. The way to adjust the condenser, therefore is to add capacity until the edges of the pulse are as sharp as possible, but with as little overshoot as possible. This is not so difficult as it sounds, because on increasing the capacity, the sharpness of the edge increases up to a point where all that happens on increasing it further is that the amount of overshoot increases too.

Having observed this, we can now reconnect the time-bases so that we have a raster on both tubes. Next, we connect the output of the video amplifier to the grid of the receiving tube (through a blocking condenser) and turn everything on again. This time, we should get a reproduction of the black band on the receiving tube, and we have our first picture.

It will be noticed that the video circuits do not contain any gain controls. For a start, it is better to do without them, but later on, we will show how this can be introduced. For a start, though, the fewer controls we have to cope with, the easier it will be to get a picture. If there is too much or too little video output, this can at first be regulated by bringing the photocell further from or closer to the transmitting raster. This gives a very fine control of the video output, and is quite sufficient for a start.

Next month, we hope to print some pictures actually photographed from the screen of the receiving C.R.T. in our own laboratory set-up, and also some photographs of the actual waveforms obtained with the test set-up we have been describing. In this way readers will be able to see both the output waveform, and the visual effect it produces, and to compare the two. There are also a number of small points to be cleared up before we go on to the next step in improving the system to give better pictures.

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VALVE NEWS

HIGH-VOLTAGE RECTIFIER EY51

A recent addition to the already large range of MULLARD Valves is the EY51 Miniature Half-wave, High Voltage Rectifier. This tube, little larger than Hearing Aid types in size, is nevertheless capable of many applications, and can be used as a power supply Rectifier for Oscilloscopes, Instruments, and Test Gear. The extremely small physical size of this MULLARD Valve enables it to be used in a very minimum of space, yet this remarkable Valve is capable of handling peak voltages up to 17 KV. Available immediately from stock, characteristics of the MULLARD EY51 are shown below:—

HEATER: 6.3 volts at 90 M/a.
CAPACITANCE: Ca-K 0.8 uuf.

LIMITING VALUES	With Sinusoidal Input	With Pulse Input
Peak Inverse Volts Max.	17	17 Kv.
Ik (Peak) Max.	4	*80 M/a
I Out Max.	0.5	0.2 M/a
Max. Reservoir Capacitance	†0.1	.005 uF.
Min. Limiting Resistance	0.1	— MΩ

***For Max. Pulse Duration 5 u Sec.**

†For 50 c/s. Operation. At other frequencies, Capacitance should be inversely proportional to Frequency.

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The "Radel" 6-Metre Amateur Receiver

PART III.—ADJUSTMENT (CONCLUDED)

The shunt can now be removed from the R.F. plate circuit, and the dial run through to see whether stability has been achieved over the whole range. If the neutralization is correct, or very nearly so, oscillation may still take place over a portion of the dial, but will disappear when the aerial is coupled to the input circuit, lowering its Q somewhat. If the best that can be done in the way of tracking and neutralization still leaves a bit of instability with the aerial uncoupled completely, this does not matter, as long as it disappears when the aerial is coupled in. However, if one wishes to be very fussy, the final trick is to shunt L_2 with the highest resistor that will just remove the instability. This can be as low as 10,000 ohms without affecting the stage gain materially. In our own case, it was found that perfectly satisfactory operation was had with no aerial coupling if 15,000 ohms or more was shunted across L_2, and that even with 10,000 ohms shunt, the stage gain was 20 times. This is excellent for an R.F. stage at over 50 mc/sec.

Although the adjustment process takes some time to describe, it does not take long in practice, as long as all the wiring is solidly and stably done, so that it cannot shift when the set is moved round.

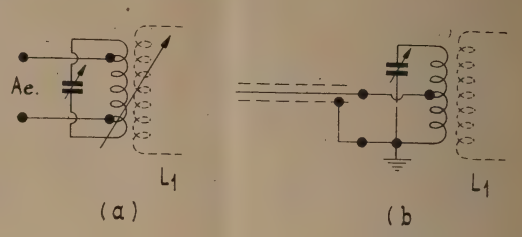
There is not the slightest sign of regeneration about the behaviour of the original set, and its operation is much easier and smoother than that of many sets working on lower frequencies.

AERIAL COUPLING

On the main circuit, no particular form of aerial coupling was shown, since alternatives are possible, and indeed necessary, to take care of different feeder systems. If a parallel-wire feeder is used, a balanced input circuit is needed. The arrangement is illustrated in Fig. 1. An additional tuned circuit is inductively coupled to L_1, and the feeders are tapped on to it at equal distances from the ends. In our own case the circuit was mounted on the end of a piece of ¼ in. bakelite rod, with flexible leads going to the aerial terminals. The rod is supported in a planetary reduction drive, which makes an excellent method of varying the coupling, since the coil is mounted on the side of the rod, and turning the rod varies the distance between the aerial coil and L_1. The coil is made from eight turns, wound similarly to the other coils, with the feeders tapped on two turns in from each end. This loads the aerial coil fairly heavily, so that when the tuning condenser is peaked at the centre of the band, no re-tuning is necessary in order to keep the sensitivity constant over the band.

Before leaving the set, it should be mentioned that the B.F.O. is coupled into the I.F. section of the set simply by stray coupling, which can be altered very easily simply by increasing or decreasing the plate feed resistor R_{19} until the desired amplitude is obtained.

An alternative aerial input arrangement for those who wish to feed the set from a co-axial cable is shown in Fig. 2. This can use the same coil as for the balanced case, but here one end is earthed, and the centre conductor of the cable is tapped on to the coil at a point that can best be determined by experiment, to give the required damping.



However, if the above instructions are carefully carried out, it will be found that when minimum signal is obtained, the neutralizing condensers are as nearly equal as can be judged by eye.

Now comes the acid test. The R.F. tube's heater is re-connected. When the main dial is now moved it should be found that over an appreciable range of its movement all is well, and no oscillation occurs. This indicates that the neutralization is very nearly correct, and that only very minor adjustments will be needed. The thing to do now is to resist the temptation to fiddle some more with the neutralizing condensers, and to proceed with tracking the input circuit, which so far has only been adjusted at mid-scale.

If the R.F. stage is oscillating at any part of the band, this must be stopped, without shifting the setting

(Concluded on Page 48.)

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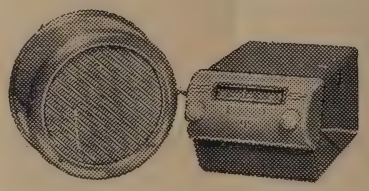

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6-Metre Receiver

(Continued from Page 46.)

of any of the condensers, before the input circuit can be tracked. The way to do this is to connect temporarily a 5000-ohm resist across the R.F. plate coil, L_2. The input circuit is then tracked, just as was done with the mixer input circuit, by adjusting the band-setting condensers for resonance at the high-frequency end of the scale, and the inductance of L_1 at the low-frequency end.

Abstracts

(Continued from Page 30.)

A second simplified article on frequency modulation. The theory is illustrated by simple vector diagrams, and an explanation of the sidebands arising from FM.

—*Wireless World* (Eng.), June, 1951, p. 239.

TELEVISION

On the television screen the light emitted does not continue to increase proportionally to the intensity of the beam because the normal phospor saturates. This effect can be overcome by an appropriate blending of the phospors.

—*Philips Technical Review*, Vol. 12, No. 4, p. 120.

A recent U.S. Supreme Court ruling approving commercial telecasting of colour video programmes in the field sequential system opens up new fields. Conversion of the present TV sets to the new freqeuncies for black and white is not difficult and new sets with colour converters are now on the market.

—*Radio and Television News* (U.S.A.), August, 1951, p. 38.

The problem of fault finding in television is one of the most complex questions met in production planning and has been done in the past by the long process of measuring voltages, etc. The idea of an automatic circuit checker with plugs pushed into valve holders is an alternative, but this takes time. A second method is of measuring actual potentials with the valves on and the use of automatic checkes, and this method is described.

MISCELLANEOUS

Millions of pounds worth of foodstuffs are spoiled every year by bacterial invasion, and ultra-violet radiation can inhibit the growth of the organisms. Notes on the construction of germicidal discharge lamps and the radiation doses are given.

—*Philips Technical Review*, Vol. 12, No. 4, p. 111.

The evaluation of quality colour reproduction poses many complex problems andd epends to some extent on human vision and judgment. Colour sensations can vary only in light saturation and brightness and for a great number of colours variations of red, green, and blue are sufficient. The paper deals with various aspects in relation to photography and television.

—*Proceedings of the I.R.E.* (U.S.A.), May, 1951, p. 468.

Standards of electroacoustics. Decisions of the American Standards Committee on terms and units in this field.

—*Ibid*, p. 509.

The British Standards Institute celebrates its Golden Jubilee in June. The article deals with some aspects of standardization with notes on the work of the main committees.

—*Electronic Engineering* (Eng.), June, 1951, p. 209.

At South Bank Exhibition and at Cambridge are radio telescopes which have been responsible for a number of discoveries, for instance, radio stars or very localized sources of emission from the heavens. Nobody knows what radio stars are, but this and other problems are under investigation.

—*Wireless World* (Eng.), July 1951, p. 227.

A colour television system for industry. A comparatively low-cost non-broadcast wired system especially adapted to manufacturing, merchandising, medical, and military fields has been developed around the image orthicon, with a field sequential system of rotating disks for colour reproduction.

—*Electrical Engineering* (U.S.A.), June, 1951, p. 517.

—*Electronic Engineering* (Eng.), June, 1951, p. 209. Part II of the theory and application of D.C. restoring circuits; to prevent "clamping" of the black level a method of gating is used so that the clamp shall not conduct on video signals.

—*Ibid*, p. 222.

An introduction to readers of phases of nuclear physics essential to civilian defence and to radiological monitoring for atomic warfare which will be of the greatest interest at the present time.

—*QST* (U.S.A.), April, 1951, p. 10, and June, p. 29.

Considerable progress is being made towards electronic exchanges wherein the switching is entirely by electronic means and the CRT tube is the basis of the switching circuits. The paper outlines the general principles.

—*The P.O. Electrical Engineers' Journal* (Eng)., April, 1951, p. 10.

A very interesting historical document dealing with the difficulties experienced with the first submarine cables.

—*Electrical Engineering* (Eng.), May, 1951, p. 379.

Solids, liquids, and gases have magnetic resonance and the discovery is of importance in the delineation of nuclear magnetic moments and magnetic field strengths as well as in the study of crystal structure and relaxation times.

—*Ibid*, p. 401.

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